

PORLAND HARBOR RI/FS
REMEDIAL INVESTIGATION REPORT

APPENDIX H
BACKGROUND SUPPORTING INFORMATION

DRAFT FINAL

**(ProUCL Output and Final Portland Harbor Sediment Background
Provided in Separate Files)**

June 12, 2015

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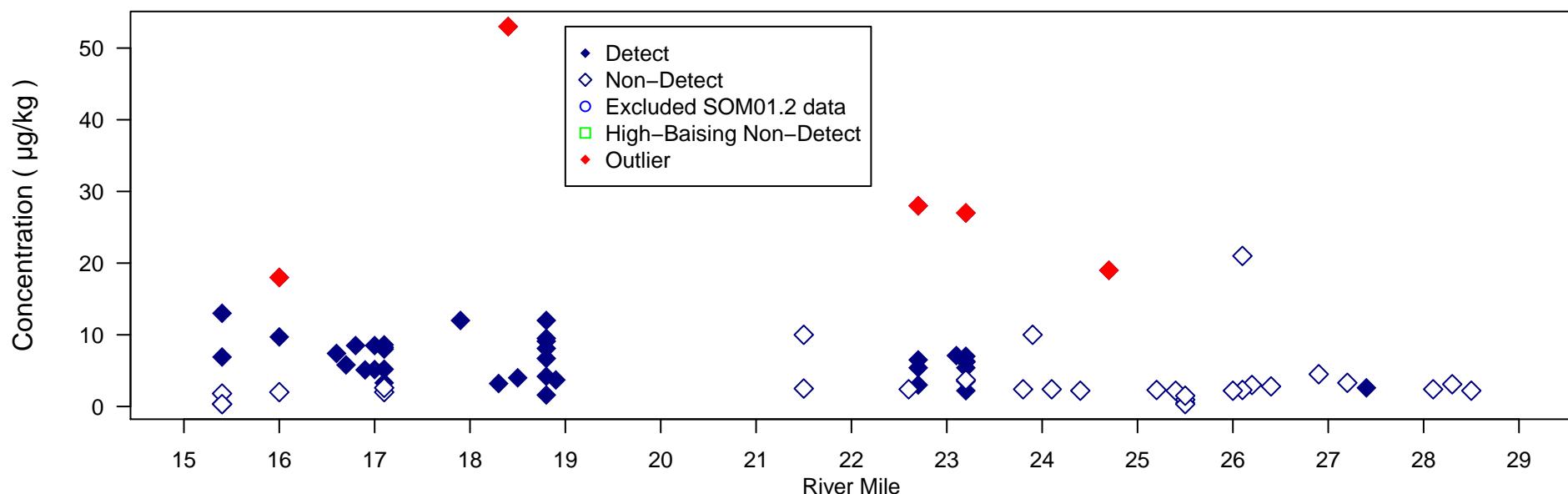
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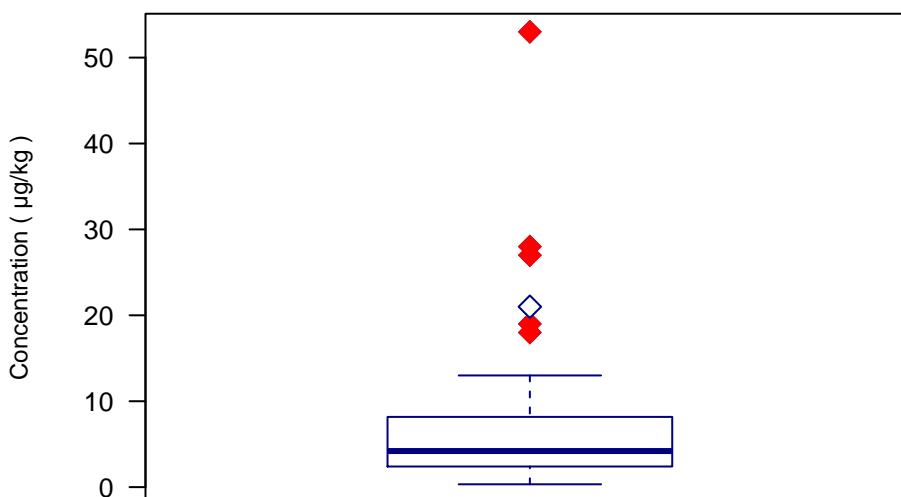
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Benzo(a)pyrene (Dry Weight) Concentration versus River Mile



Boxplot



Quantile–Quantile Plot

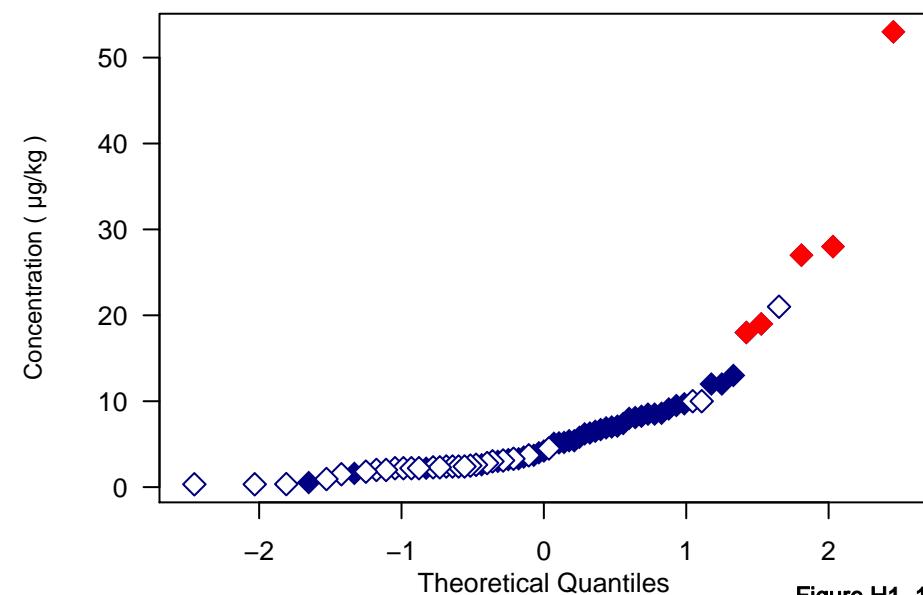
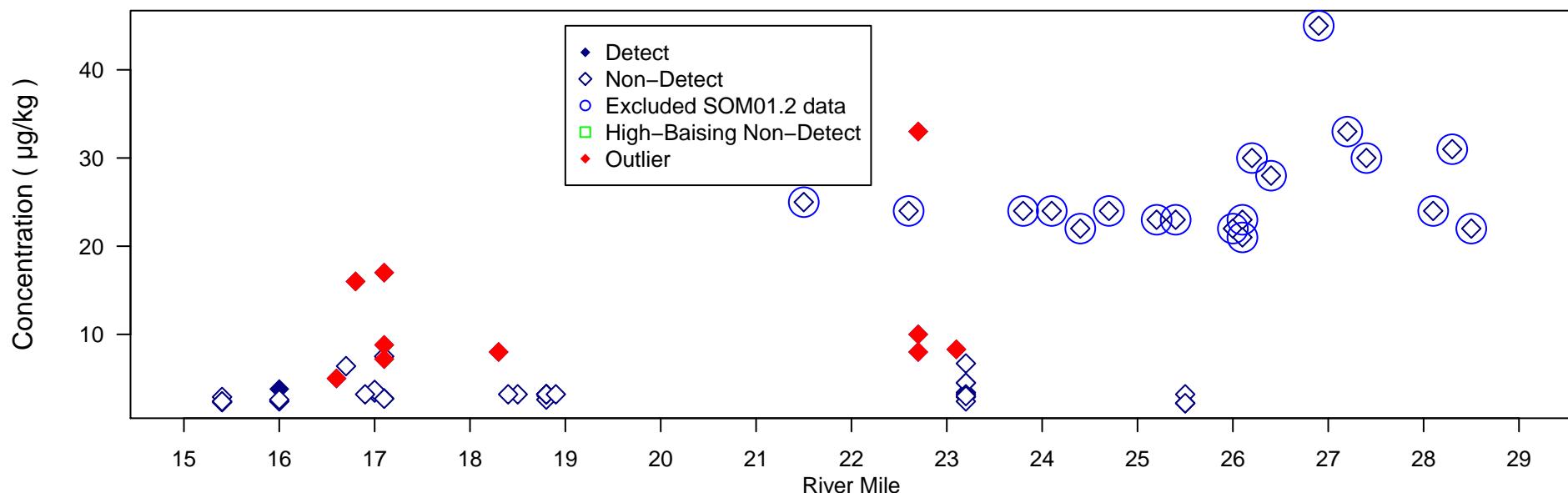
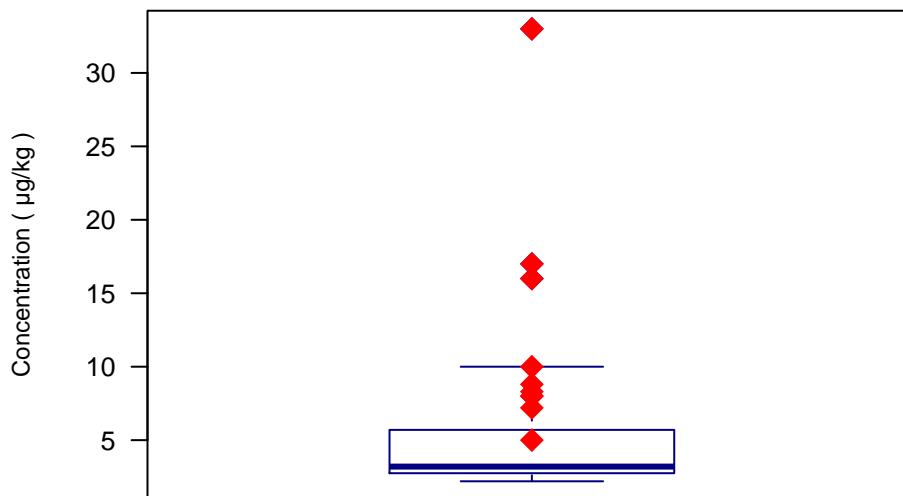


Figure H1-1
Portland Harbor RI/FS
Remedial Investigation Report
Background Upriver Bedded Sediment Outlier Analysis
Benzo(a)pyrene (Dry Weight)

Butylbenzyl phthalate (Dry Weight) Concentration versus River Mile



Boxplot



Quantile–Quantile Plot

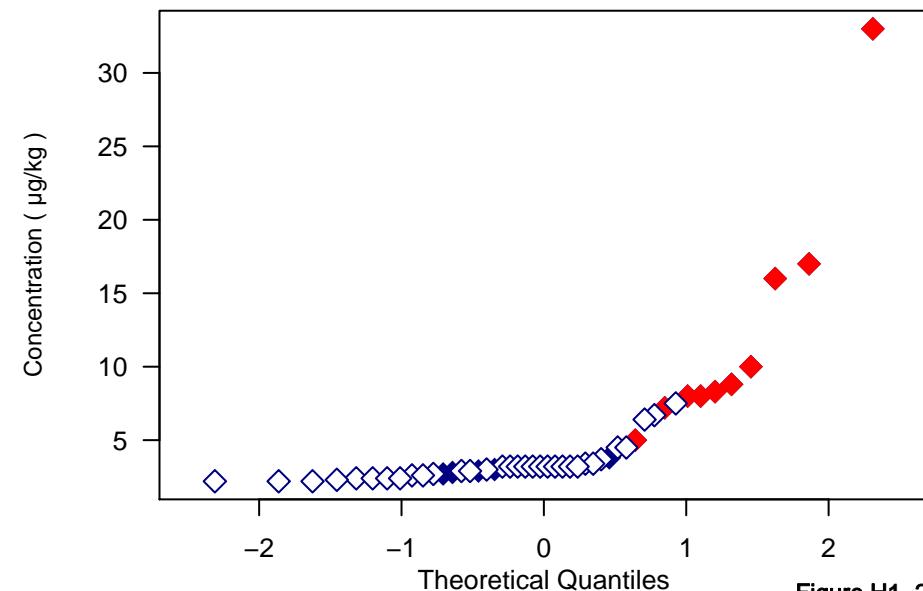
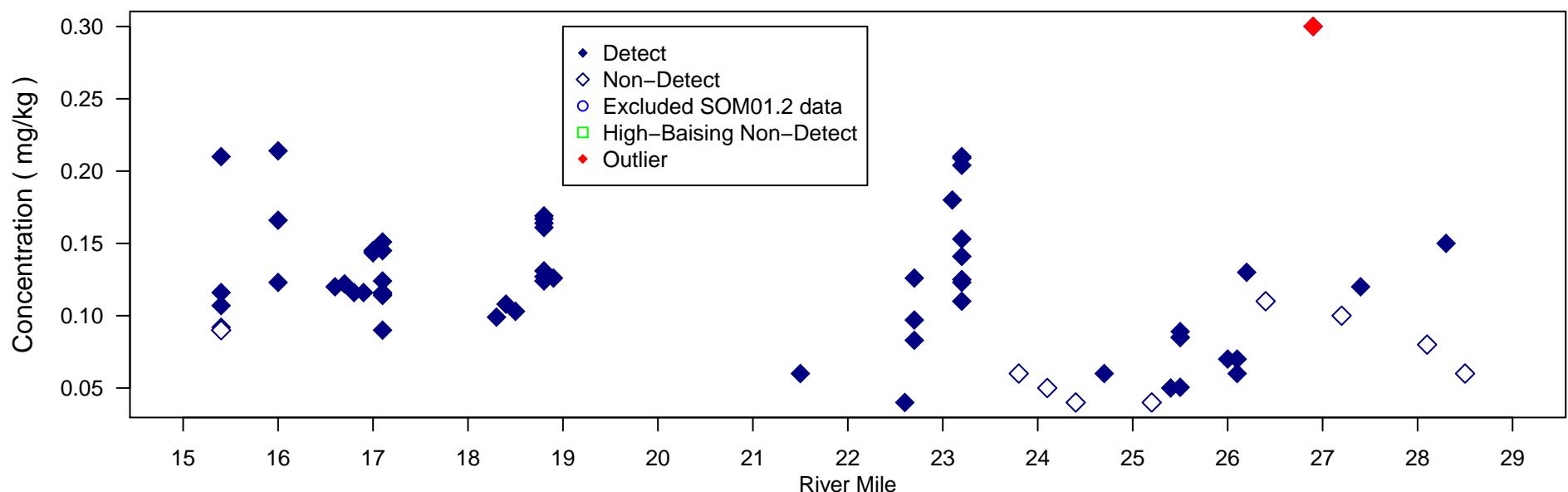
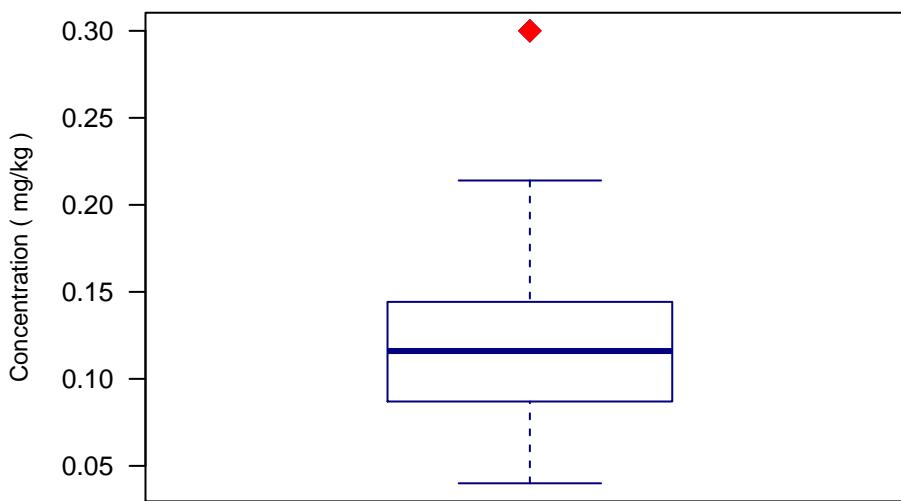


Figure H1-2
Portland Harbor RI/FS
Remedial Investigation Report
Background Upriver Bedded Sediment Outlier Analysis
Butylbenzyl phthalate (Dry Weight)

Cadmium (Dry Weight) Concentration versus River Mile



Boxplot



Quantile–Quantile Plot

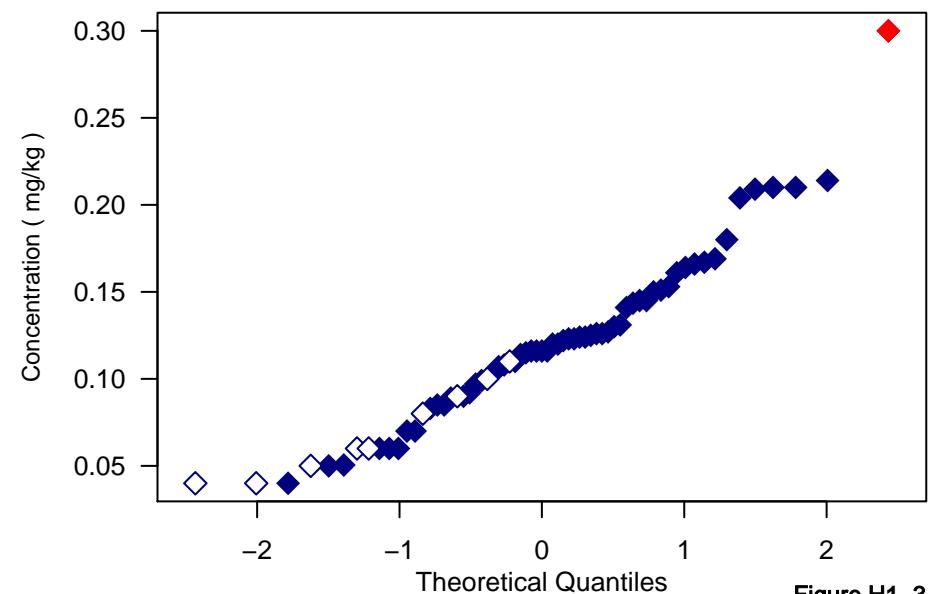
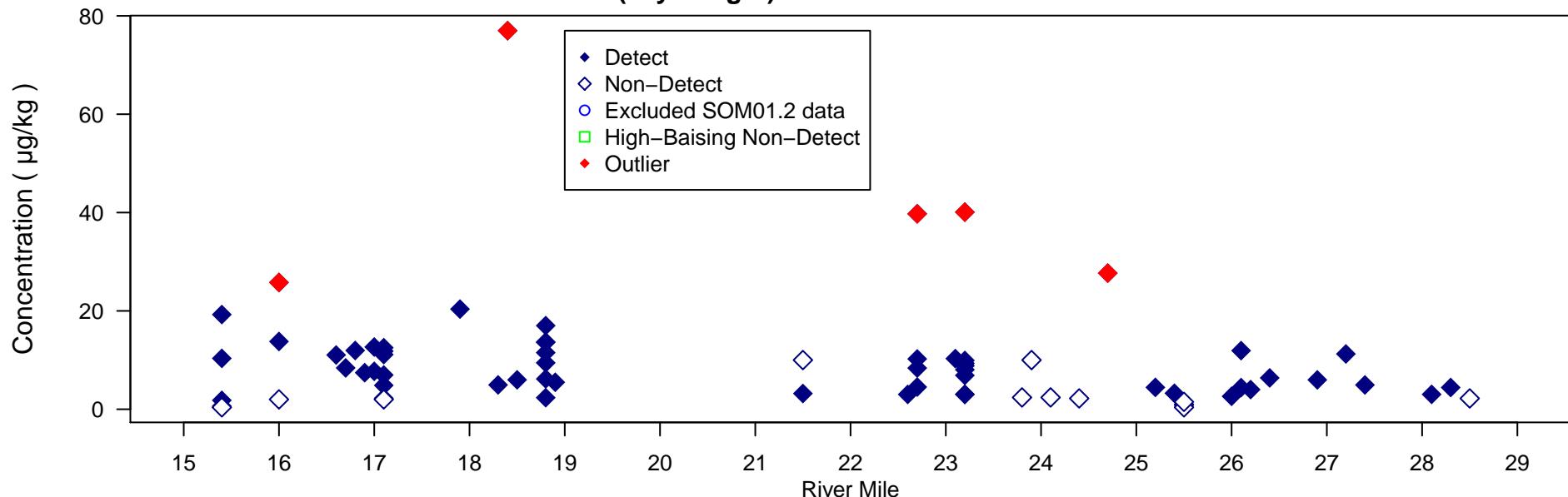
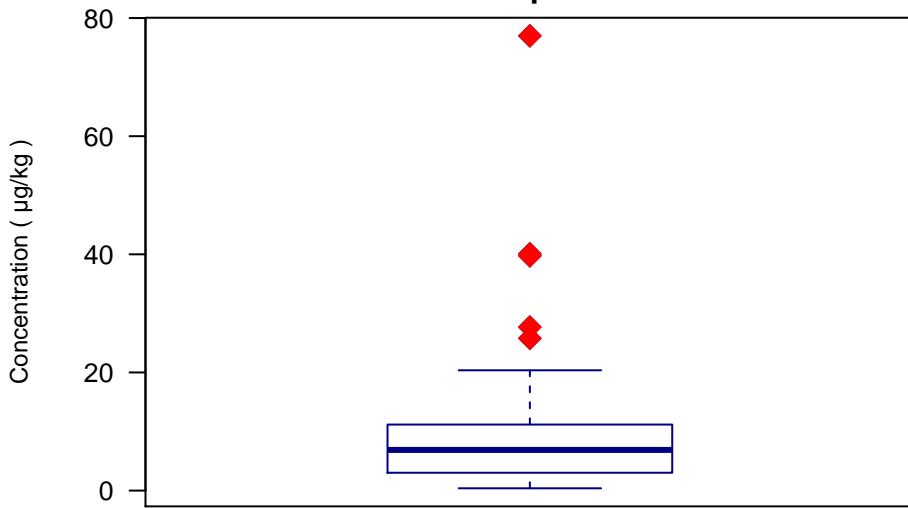


Figure H1–3
Portland Harbor RI/FS
Remedial Investigation Report
Background Upriver Bedded Sediment Outlier Analysis
Cadmium (Dry Weight)

cPAHs (Dry Weight) Concentration versus River Mile



Boxplot



Quantile–Quantile Plot

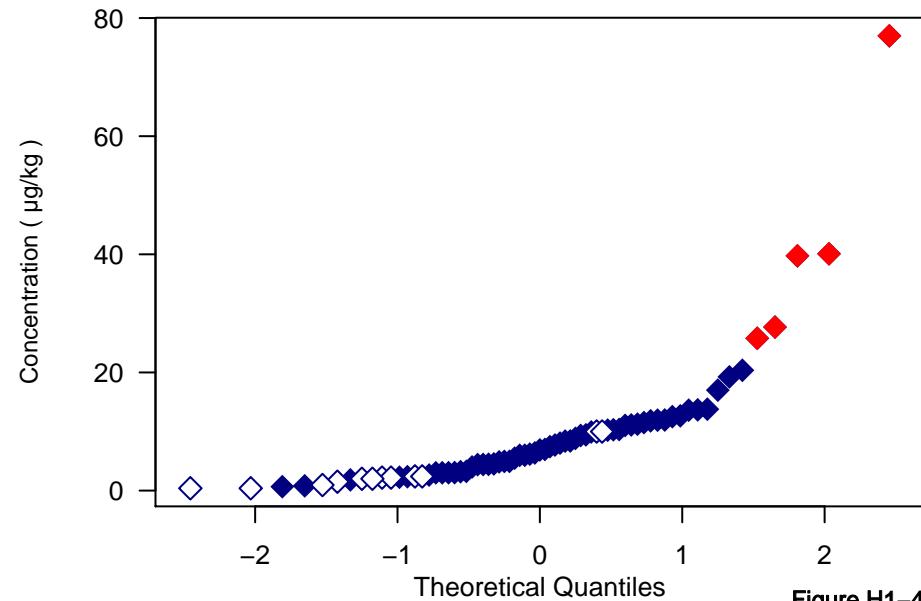
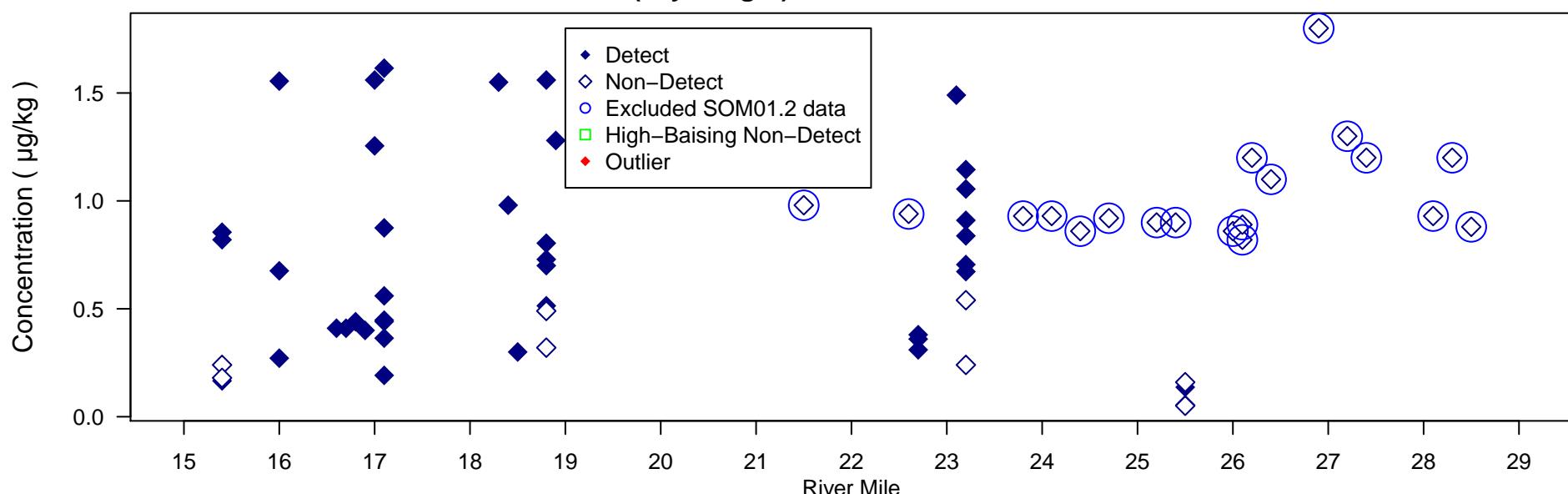
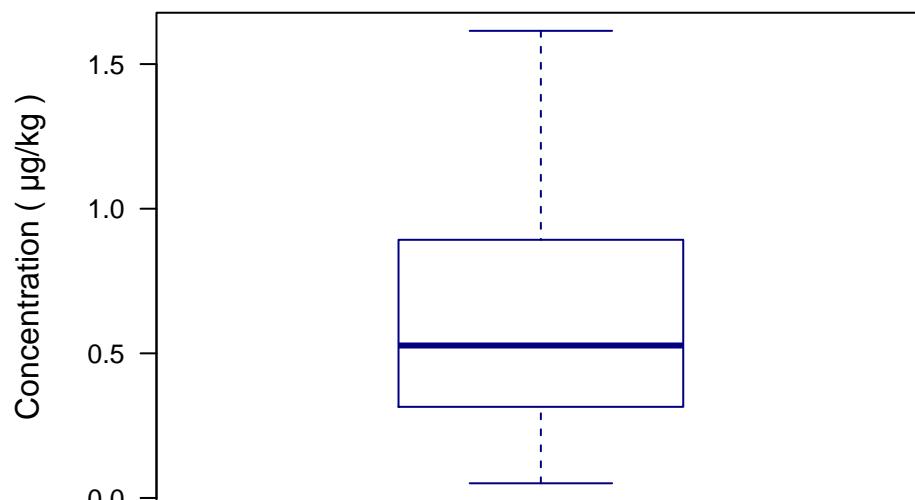


Figure H1-4
Portland Harbor RI/FS
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Background Upriver Bedded Sediment Outlier Analysis
cPAHs (Dry Weight)

Total DDD (Dry Weight) Concentration versus River Mile



Boxplot



Quantile–Quantile Plot

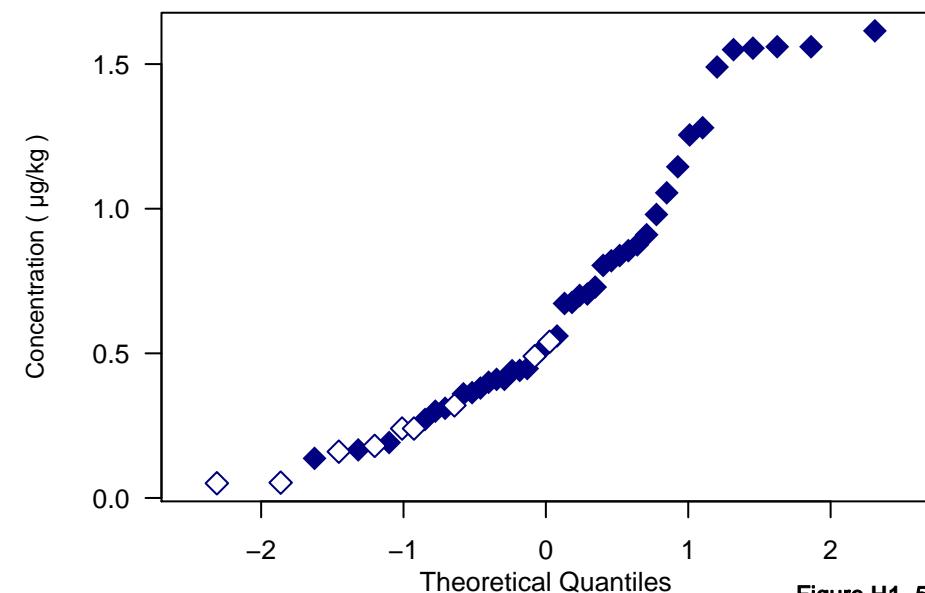
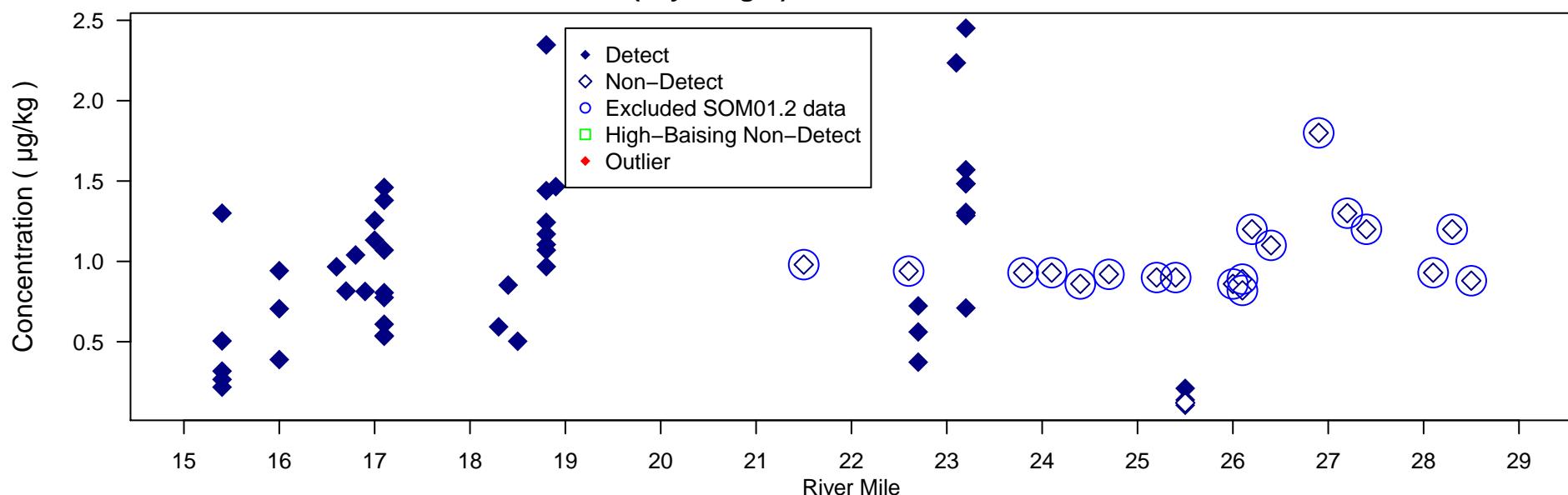
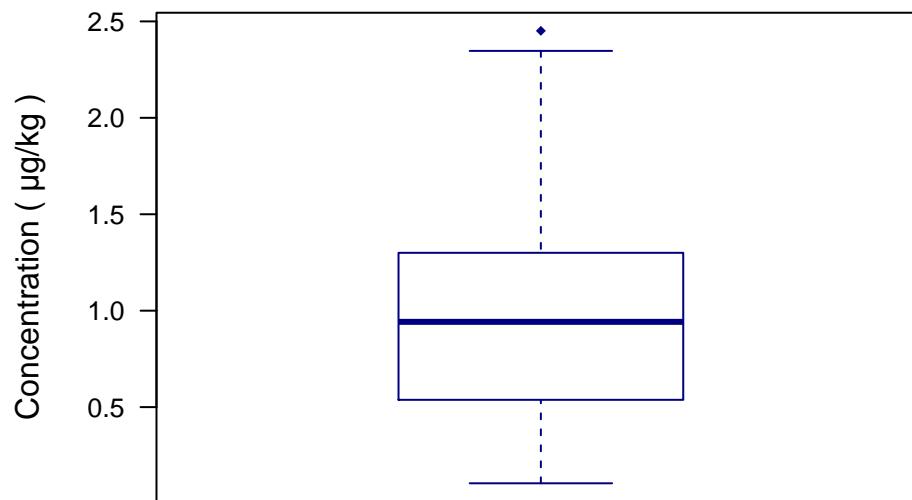


Figure H1-5
Portland Harbor RI/FS
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Background Upriver Bedded Sediment Outlier Analysis
Total DDD (Dry Weight)

Total DDE (Dry Weight) Concentration versus River Mile



Boxplot



Quantile–Quantile Plot

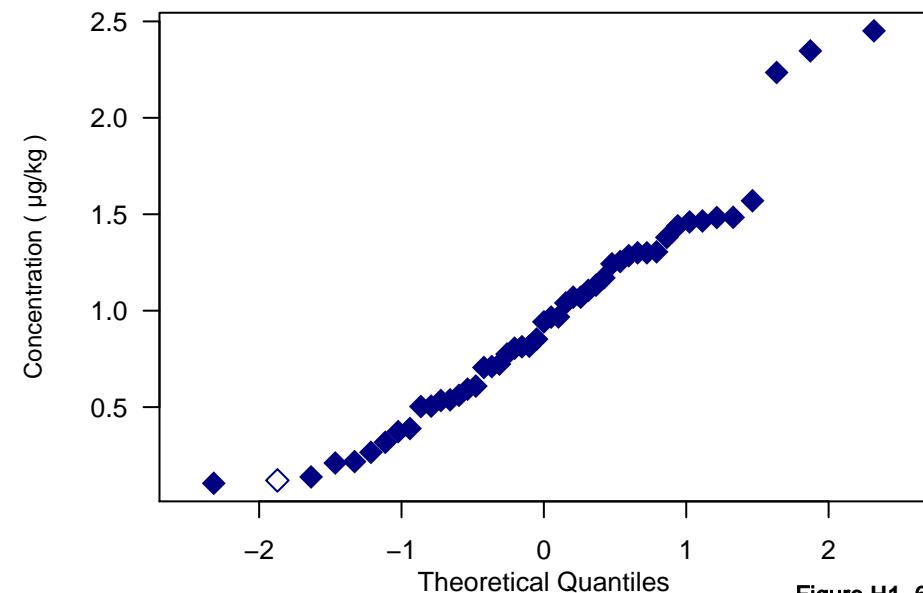
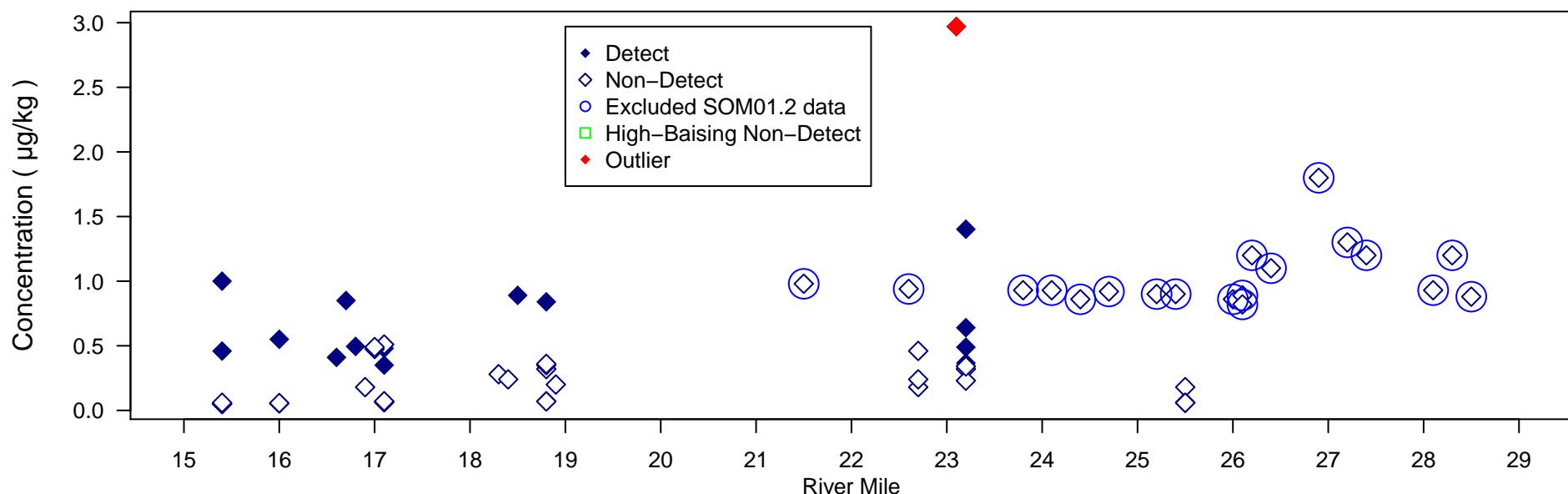
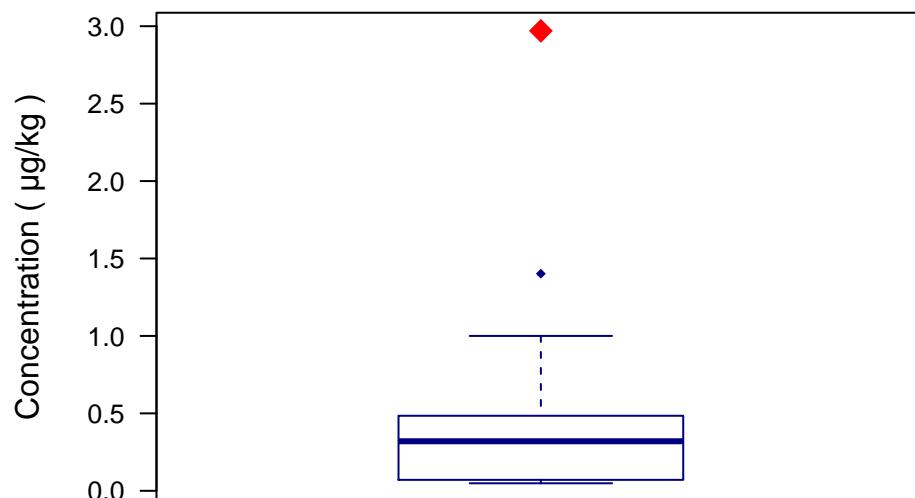


Figure H1–6
Portland Harbor RI/FS
Remedial Investigation Report
Background Upriver Bedded Sediment Outlier Analysis
Total DDE (Dry Weight)

Total DDT (Dry Weight) Concentration versus River Mile



Boxplot



Quantile–Quantile Plot

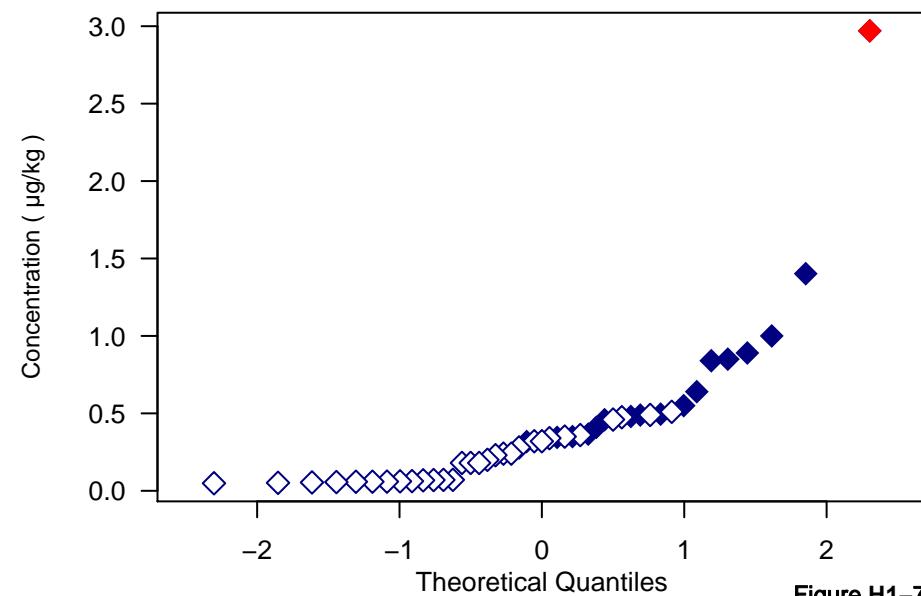
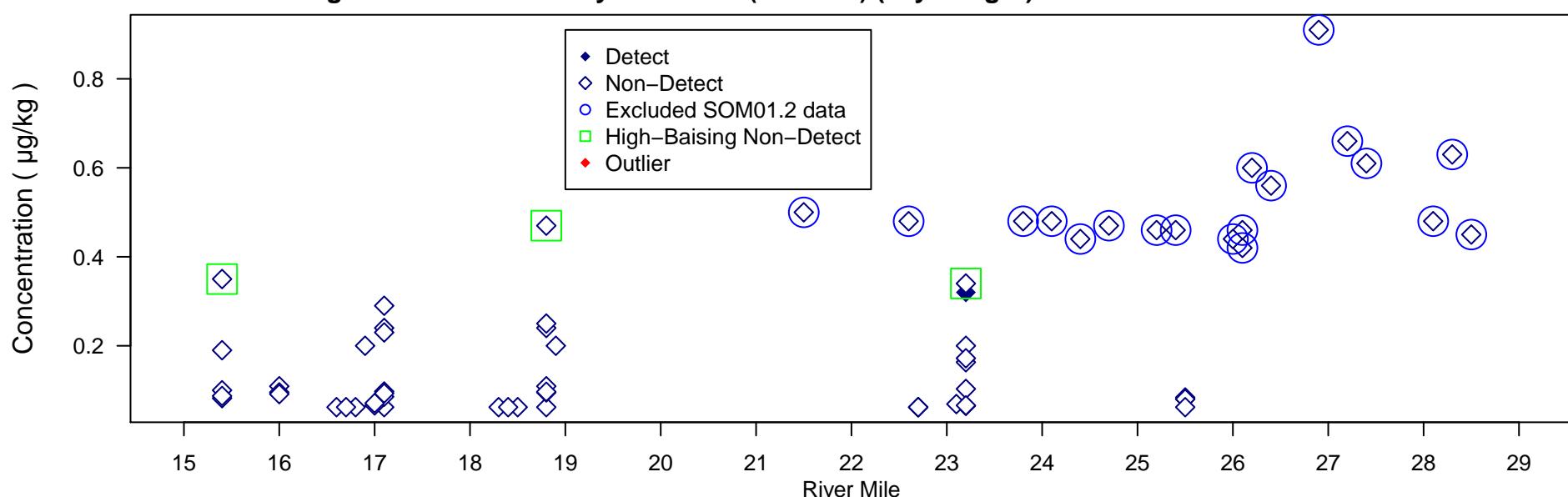
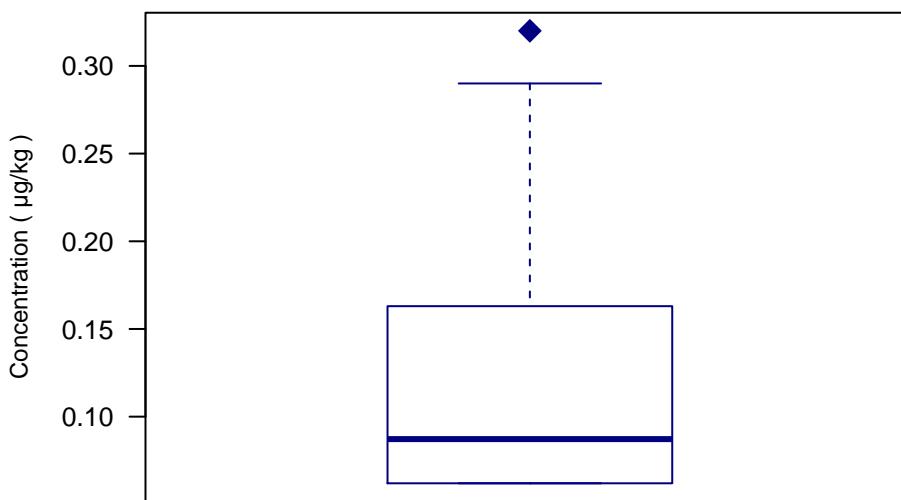


Figure H1–7
Portland Harbor RI/FS
Remedial Investigation Report
Background Upriver Bedded Sediment Outlier Analysis
Total DDT (Dry Weight)

gamma-Hexachlorocyclohexane (Lindane) (Dry Weight) Concentration versus River Mile



Boxplot



Quantile–Quantile Plot

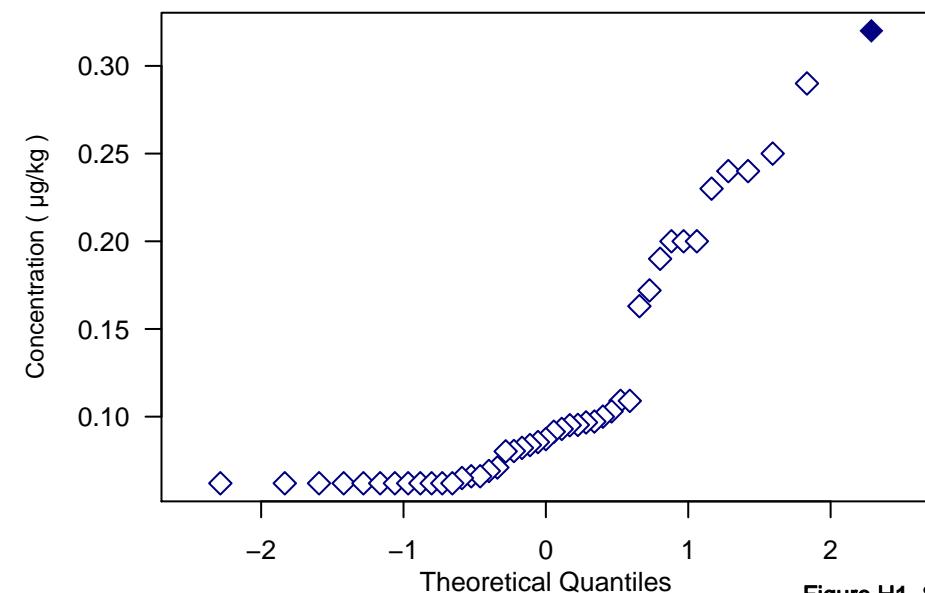
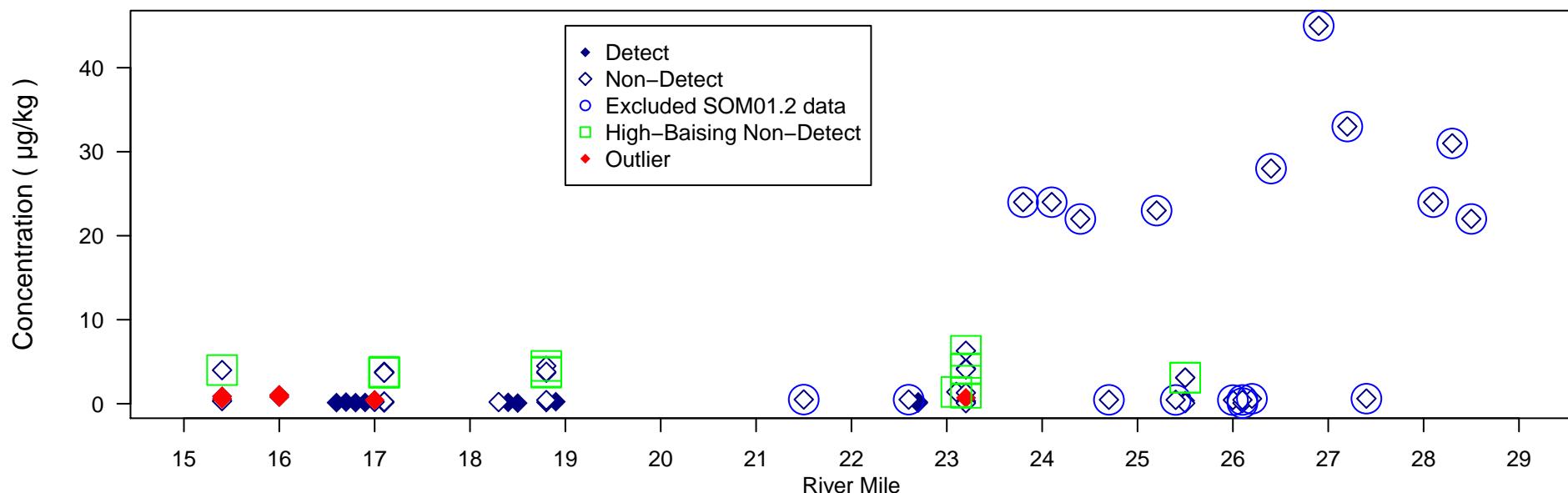
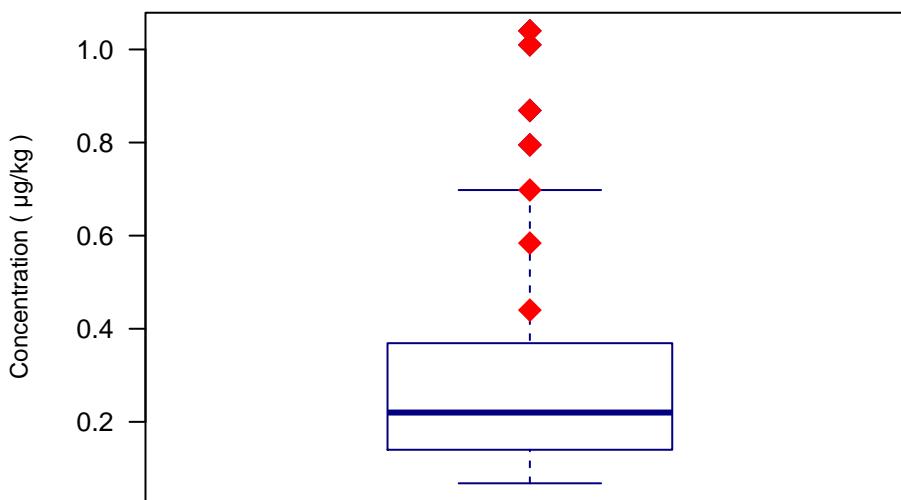


Figure H1-8
Portland Harbor RI/FS
Remedial Investigation Report
Background Upriver Bedded Sediment Outlier Analysis
gamma-Hexachlorocyclohexane (Lindane) (Dry Weight)

Hexachlorobenzene (Dry Weight) Concentration versus River Mile



Boxplot



Quantile–Quantile Plot

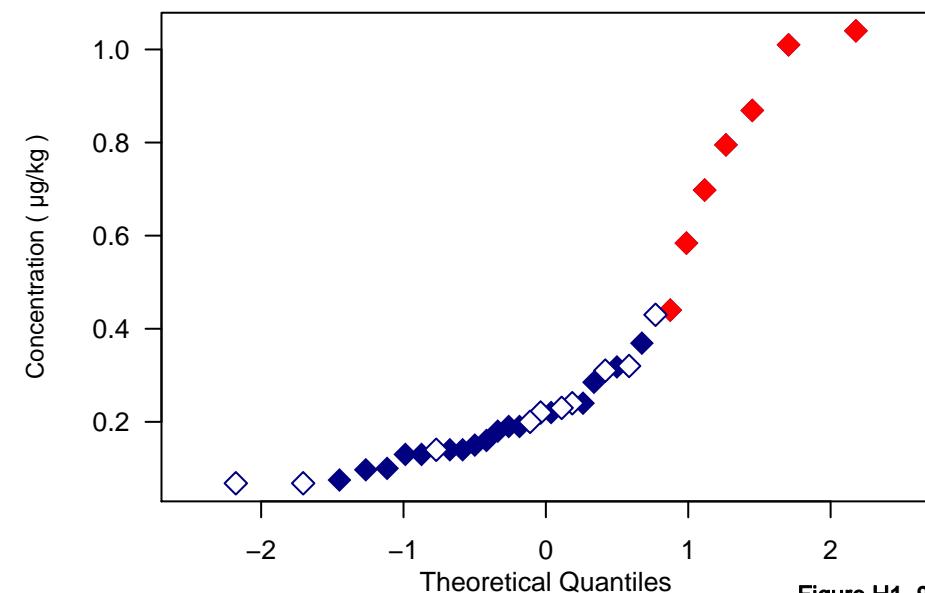
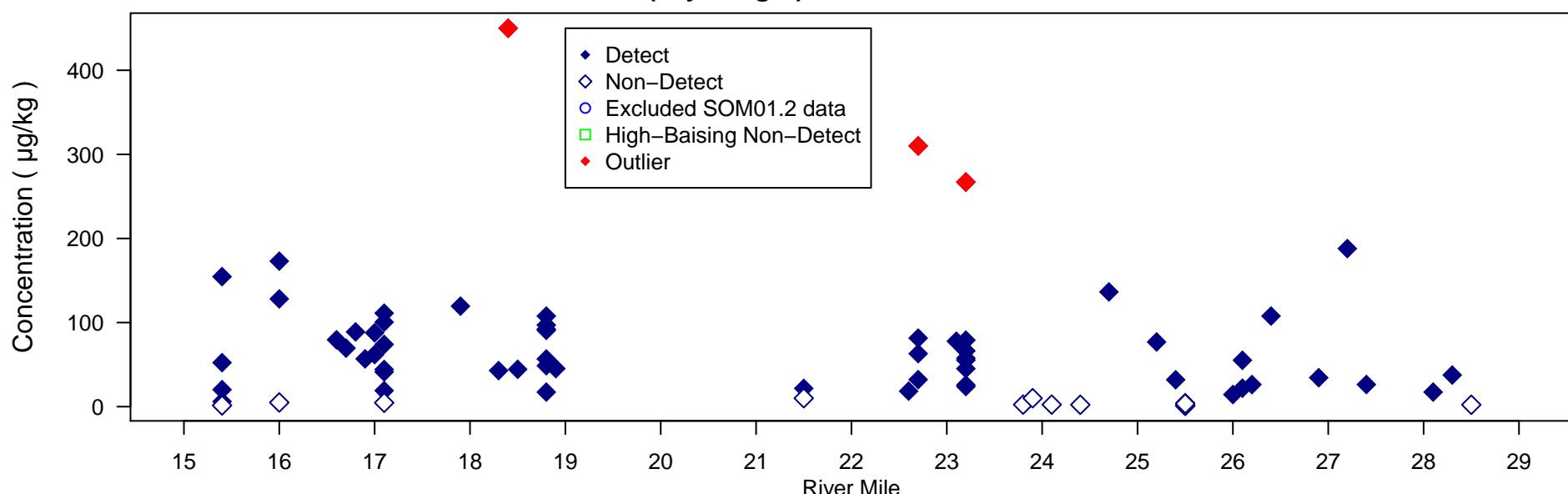
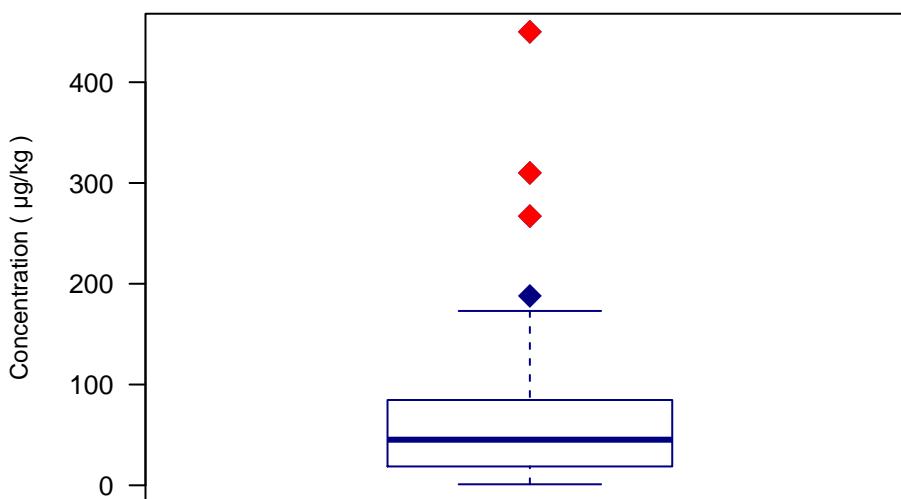


Figure H1-9
Portland Harbor RI/FS
Remedial Investigation Report
Background Upriver Bedded Sediment Outlier Analysis
Hexachlorobenzene (Dry Weight)

Total HPAHs (Dry Weight) Concentration versus River Mile



Boxplot



Quantile–Quantile Plot

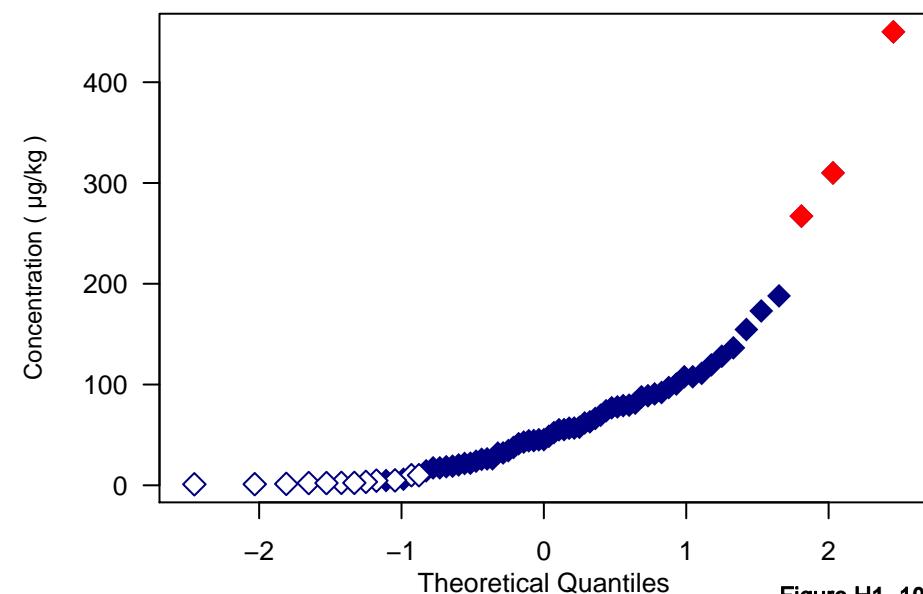
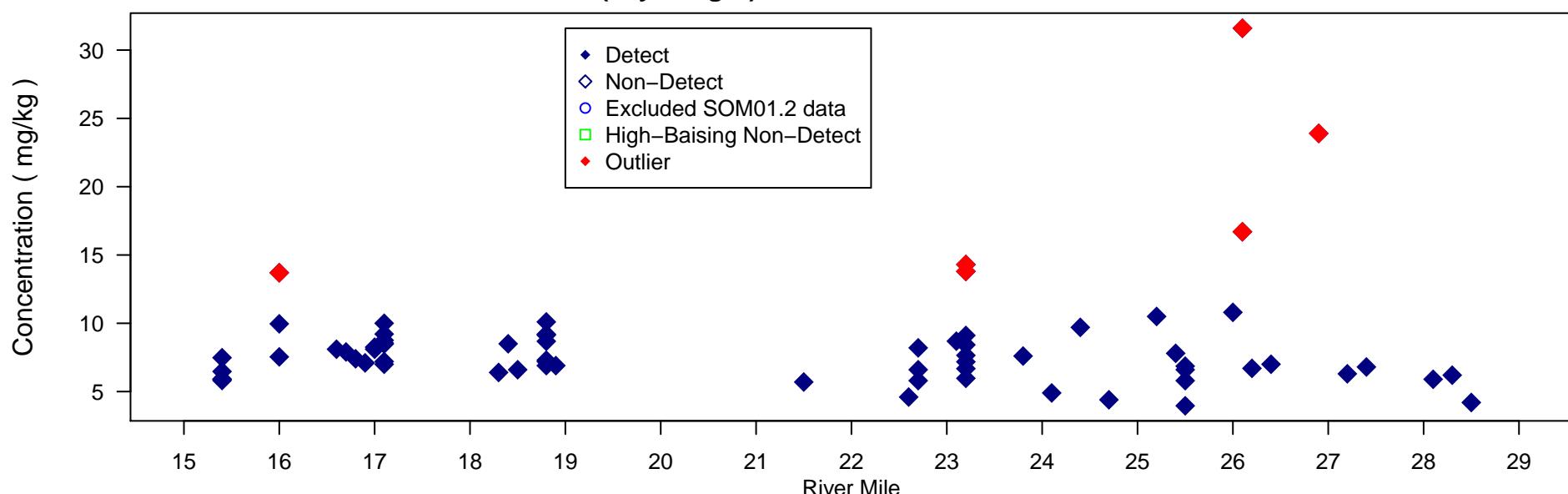
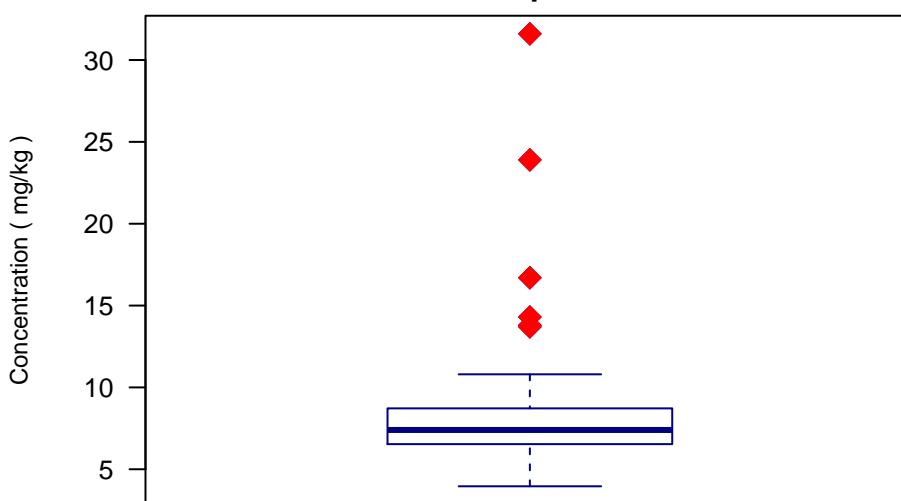


Figure H1-10
Portland Harbor RI/FS
Remedial Investigation Report
Background Upriver Bedded Sediment Outlier Analysis
Total HPAHs (Dry Weight)

Lead (Dry Weight) Concentration versus River Mile



Boxplot



Quantile–Quantile Plot

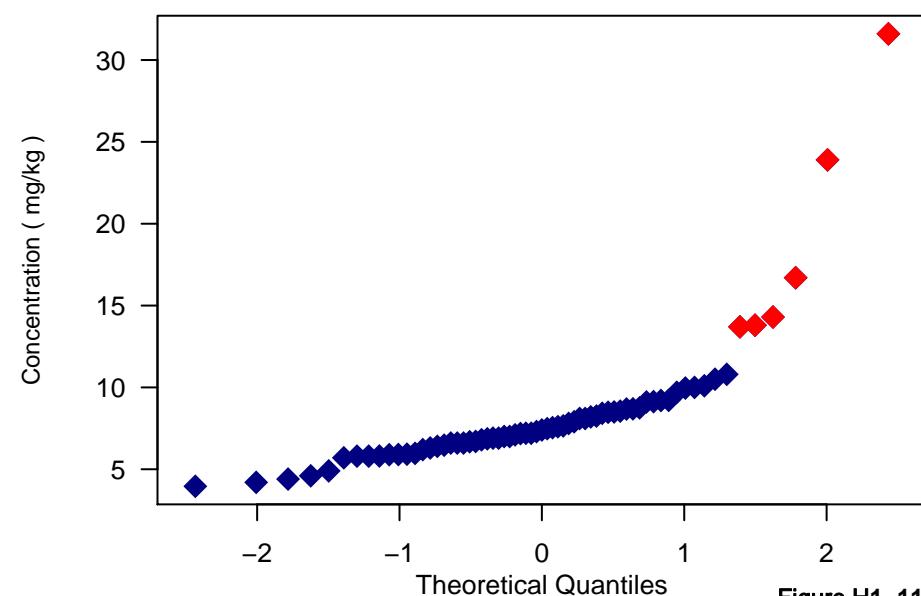
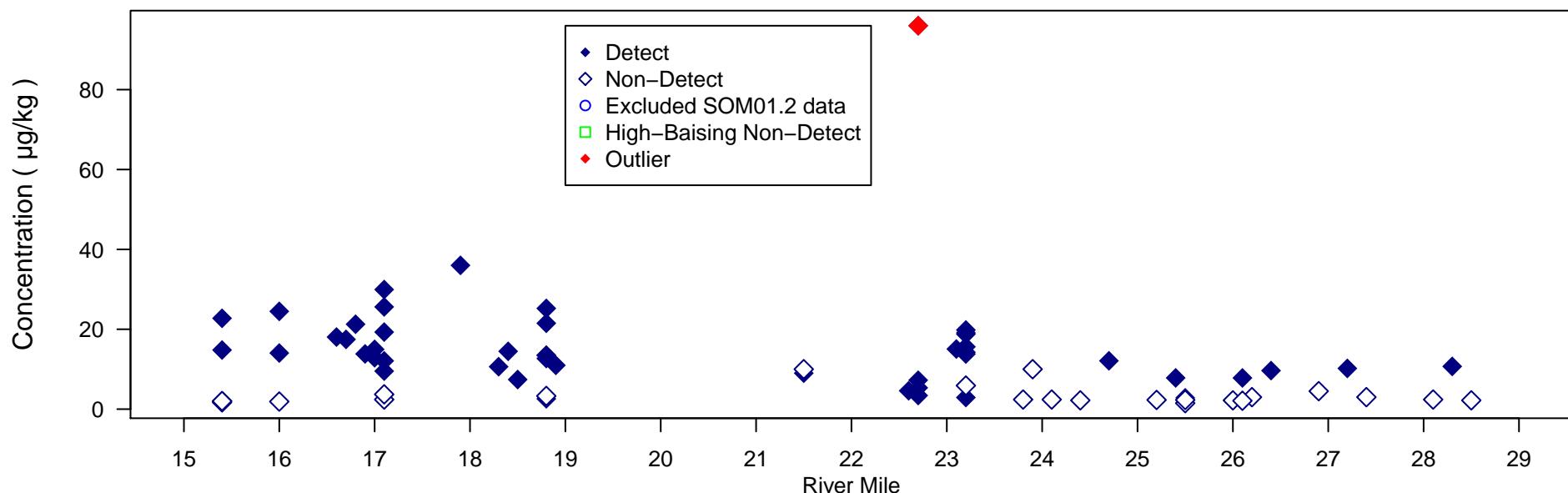
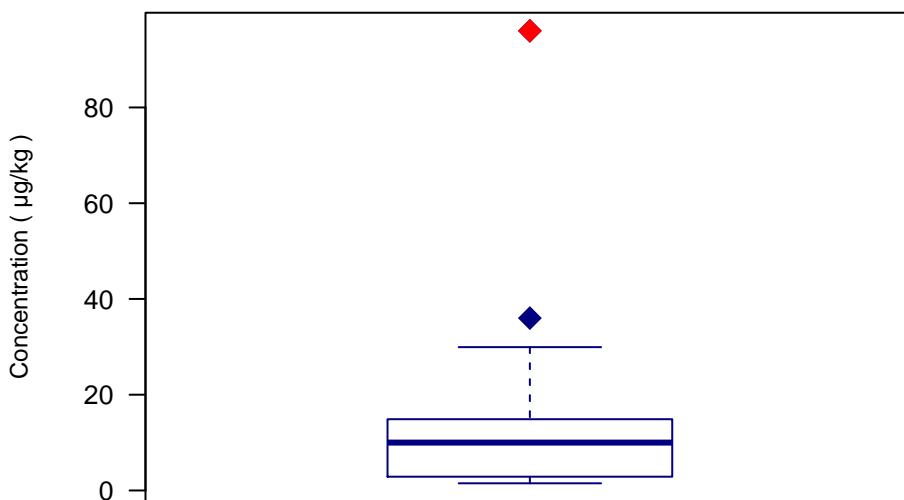


Figure H1-11
Portland Harbor RI/FS
Remedial Investigation Report
Background Upriver Bedded Sediment Outlier Analysis
Lead (Dry Weight)

Total LPAHs (Dry Weight) Concentration versus River Mile



Boxplot



Quantile–Quantile Plot

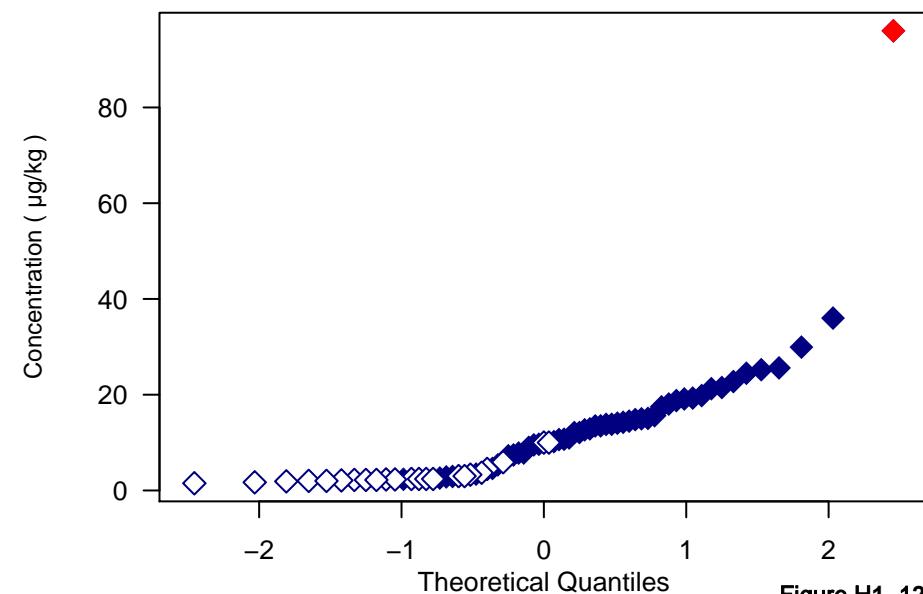
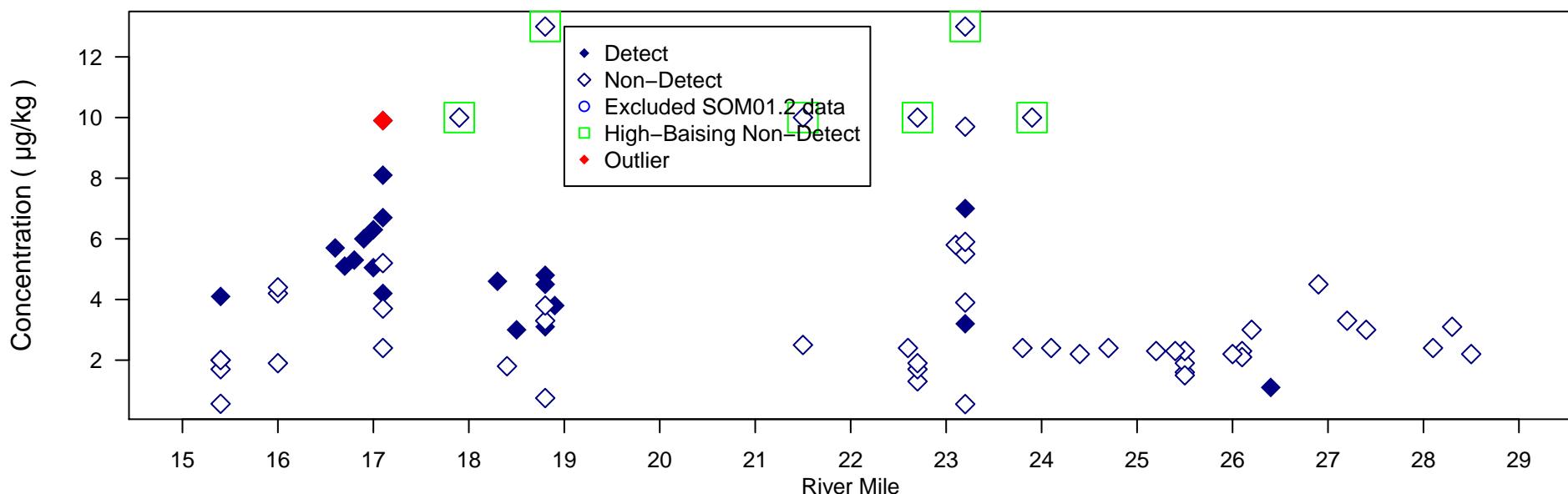
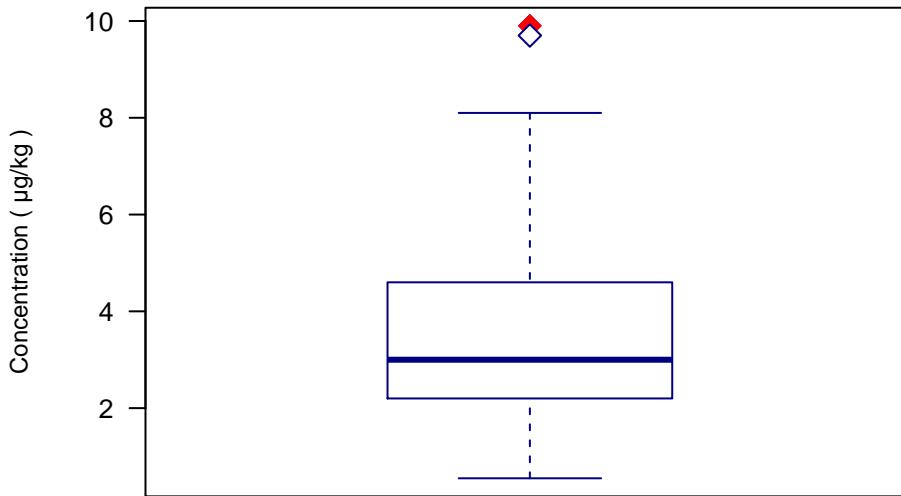


Figure H1-12
Portland Harbor RI/FS
Remedial Investigation Report
Background Upriver Bedded Sediment Outlier Analysis
Total LPAHs (Dry Weight)

Naphthalene (Dry Weight) Concentration versus River Mile



Boxplot



Quantile–Quantile Plot

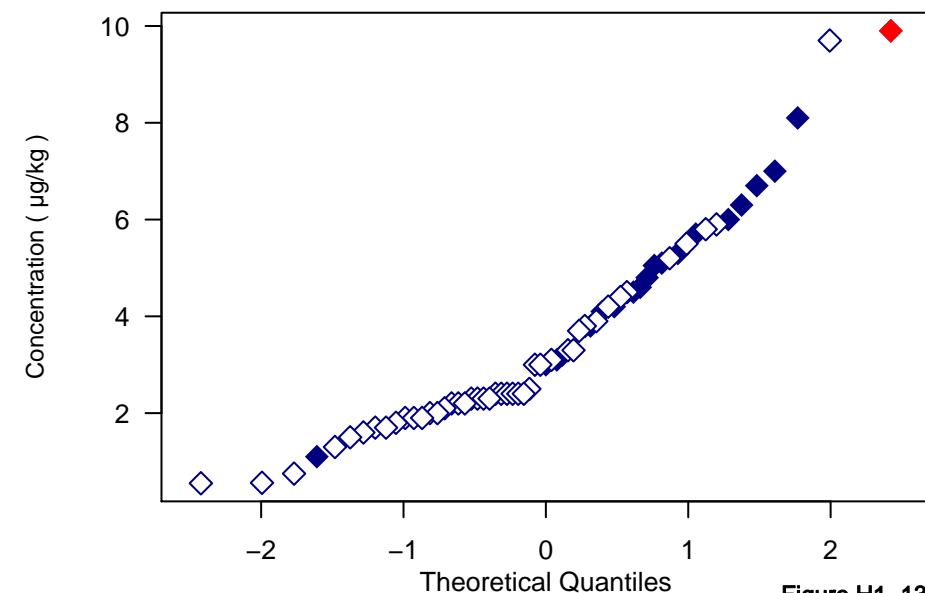
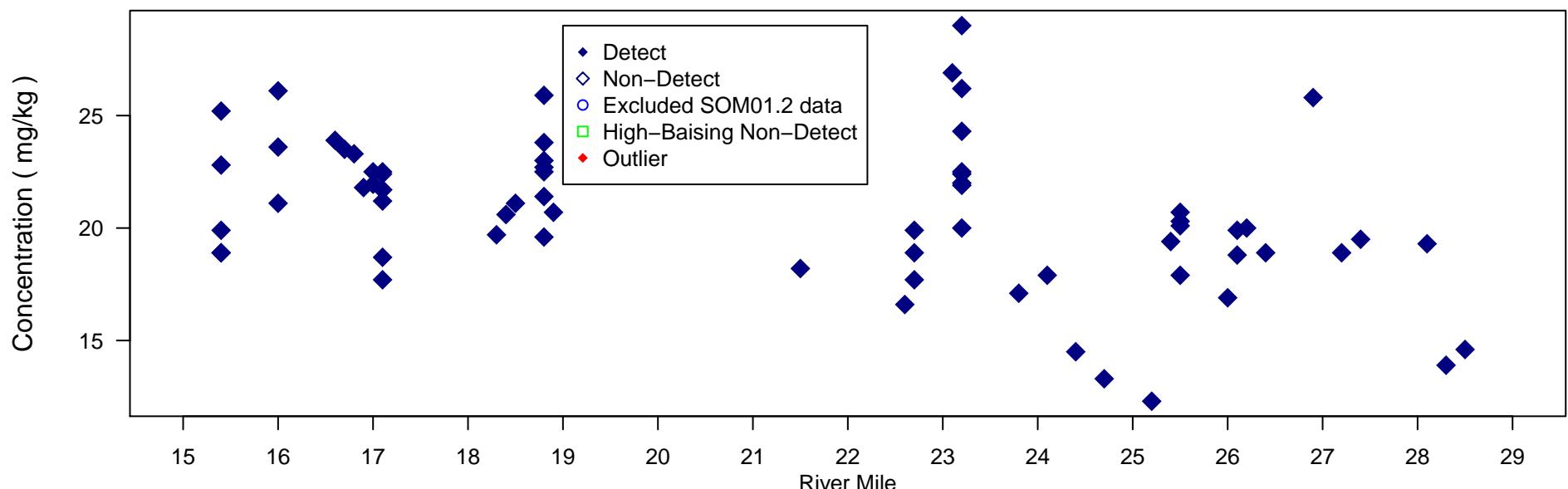
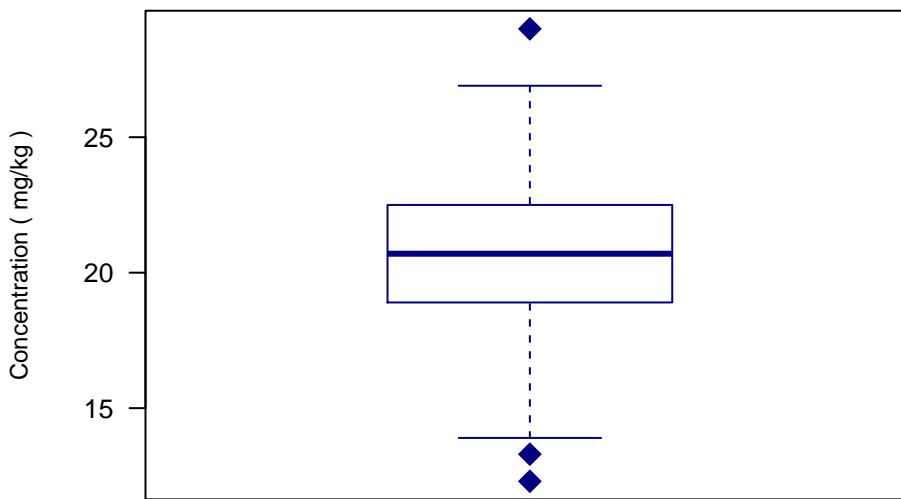


Figure H1-13
Portland Harbor RI/FS
Remedial Investigation Report
Background Upriver Bedded Sediment Outlier Analysis
Naphthalene (Dry Weight)

Nickel (Dry Weight) Concentration versus River Mile



Boxplot



Quantile–Quantile Plot

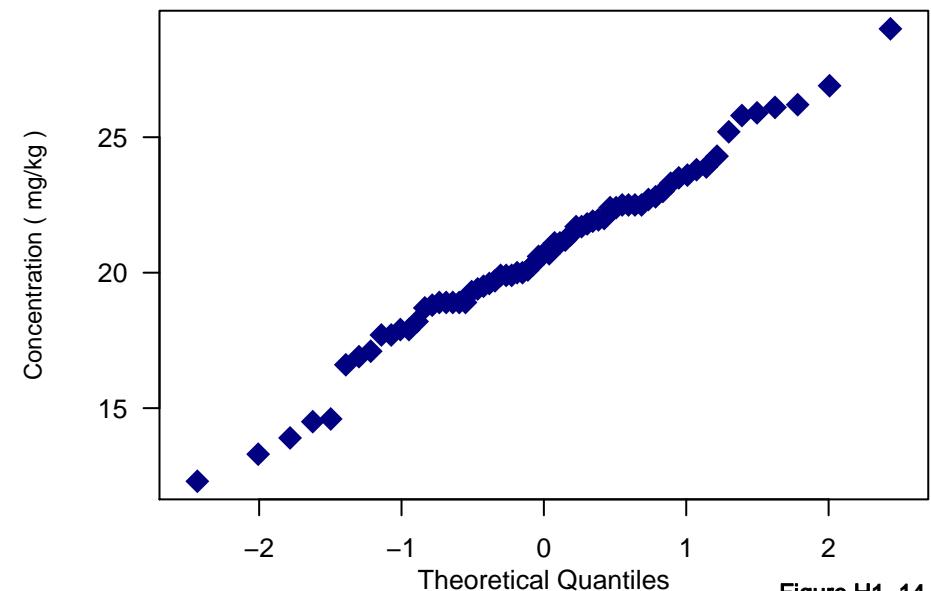
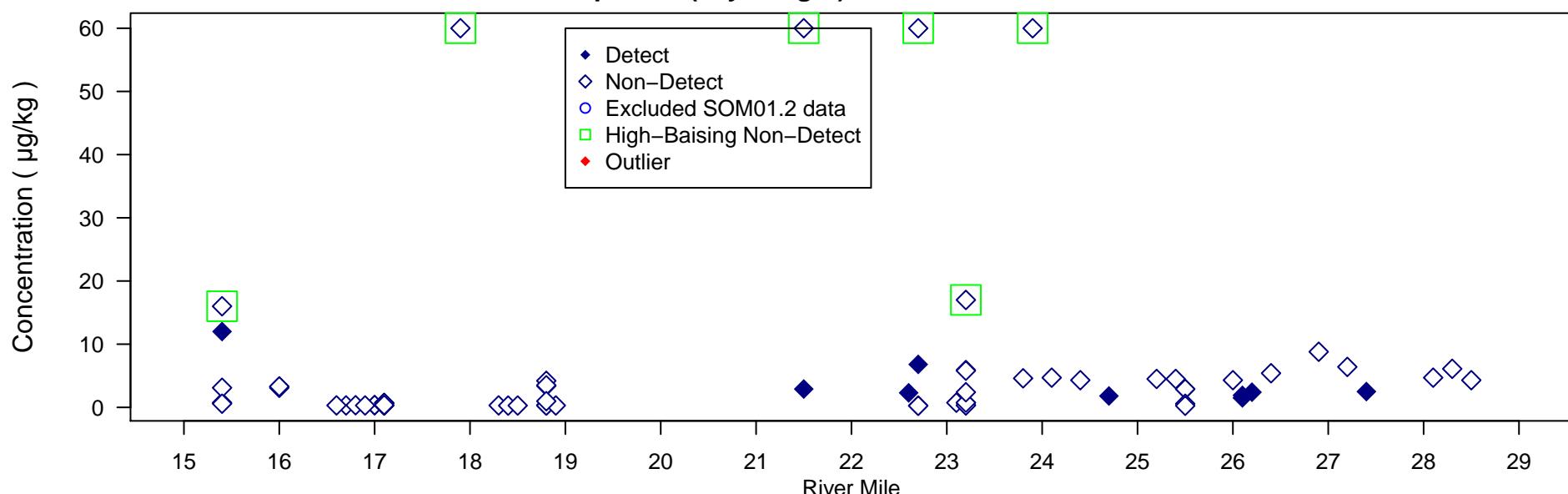
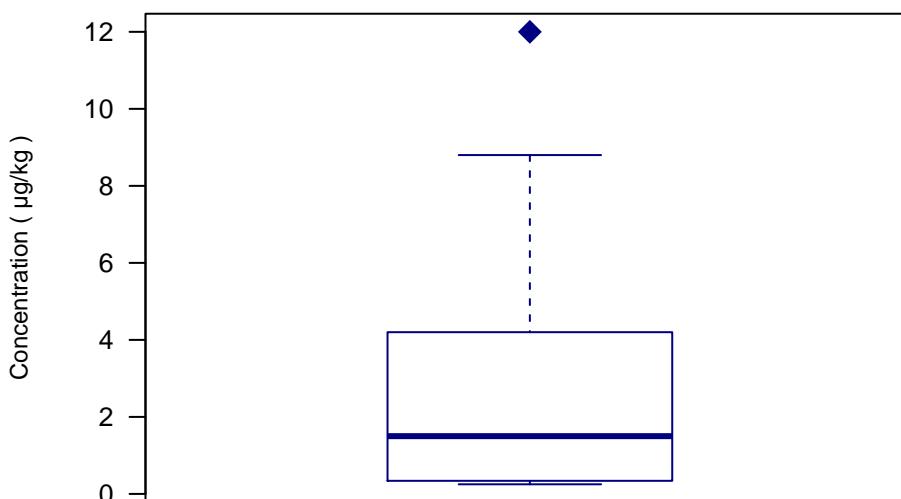


Figure H1-14
Portland Harbor RI/FS
Remedial Investigation Report
Background Upriver Bedded Sediment Outlier Analysis
Nickel (Dry Weight)

Pentachlorophenol (Dry Weight) Concentration versus River Mile



Boxplot



Quantile–Quantile Plot

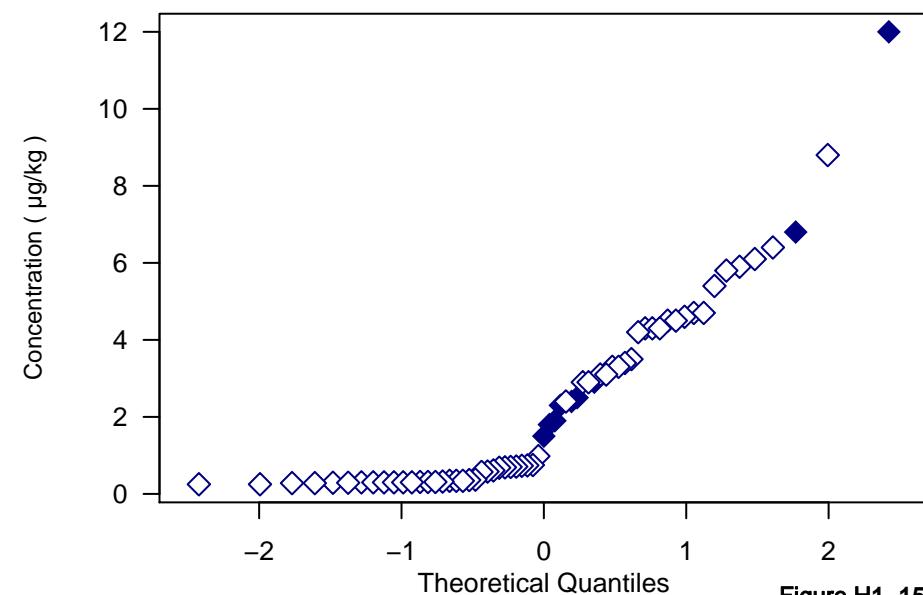
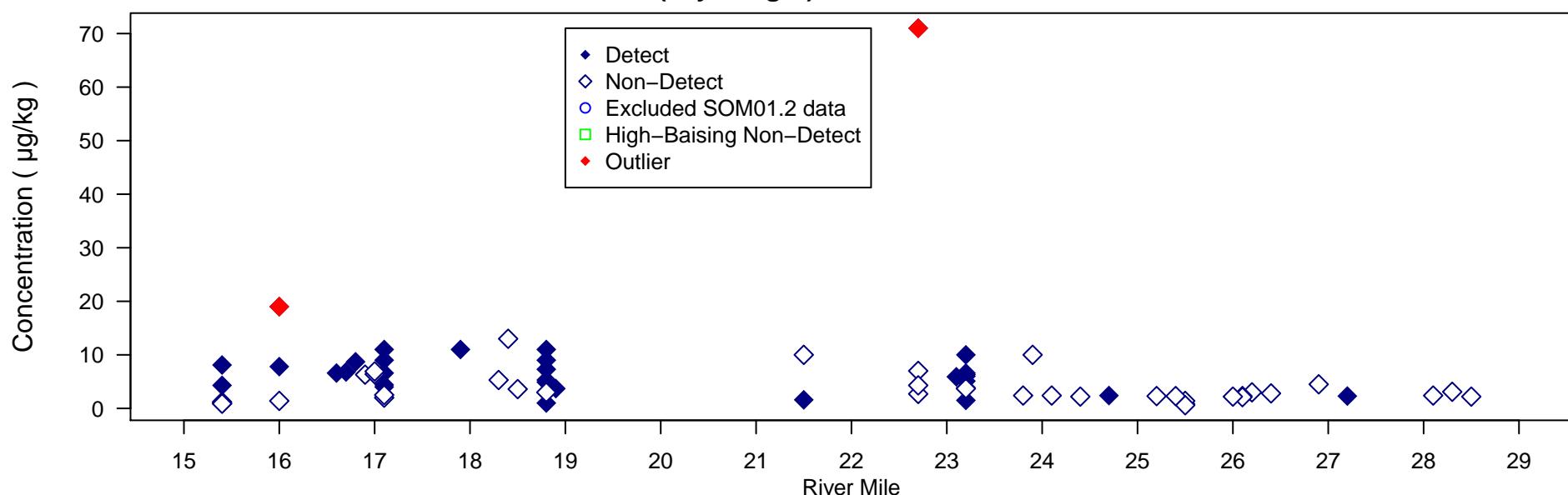
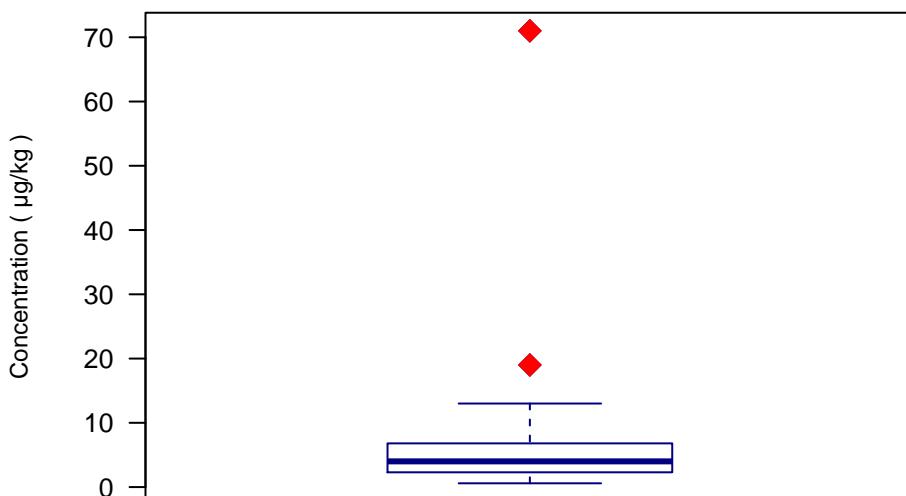


Figure H1-15
Portland Harbor RI/FS
Remedial Investigation Report
Background Upriver Bedded Sediment Outlier Analysis
Pentachlorophenol (Dry Weight)

Phenanthrene (Dry Weight) Concentration versus River Mile



Boxplot



Quantile–Quantile Plot

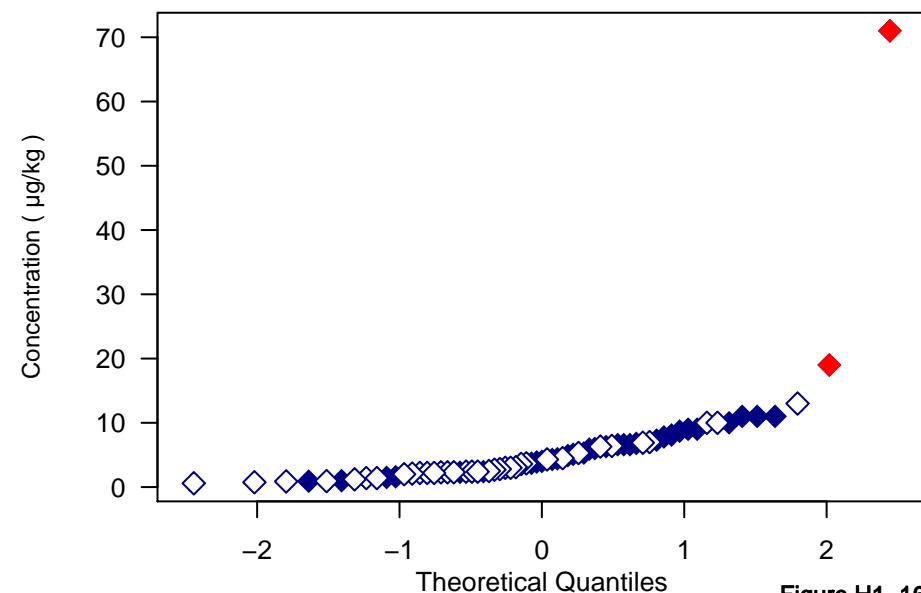
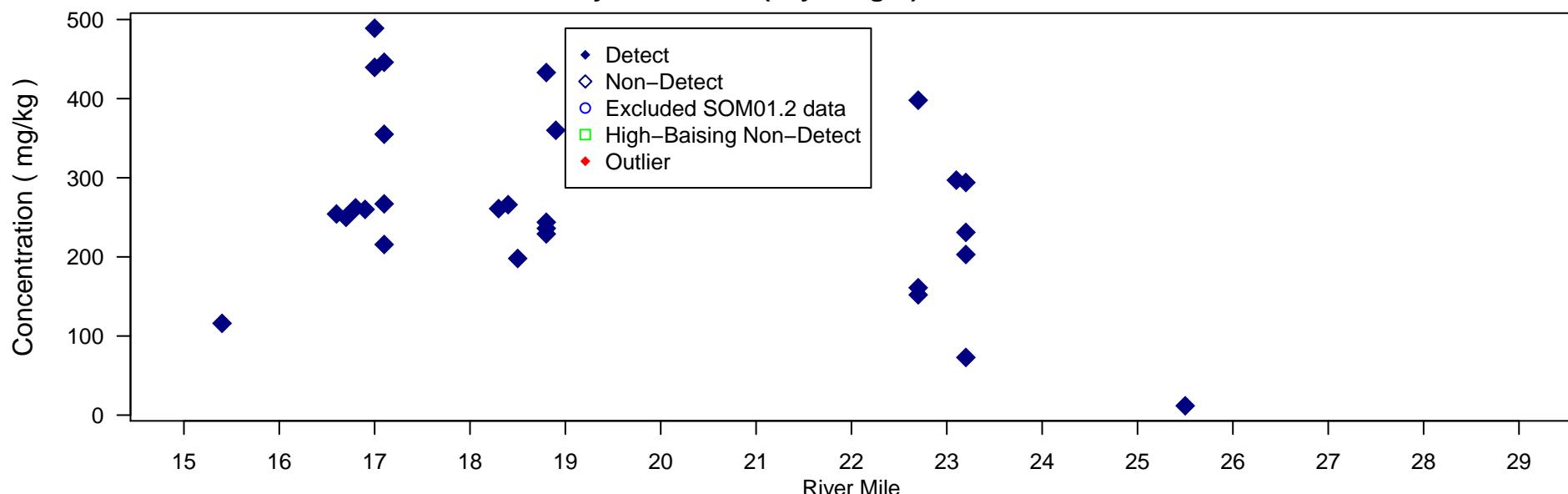
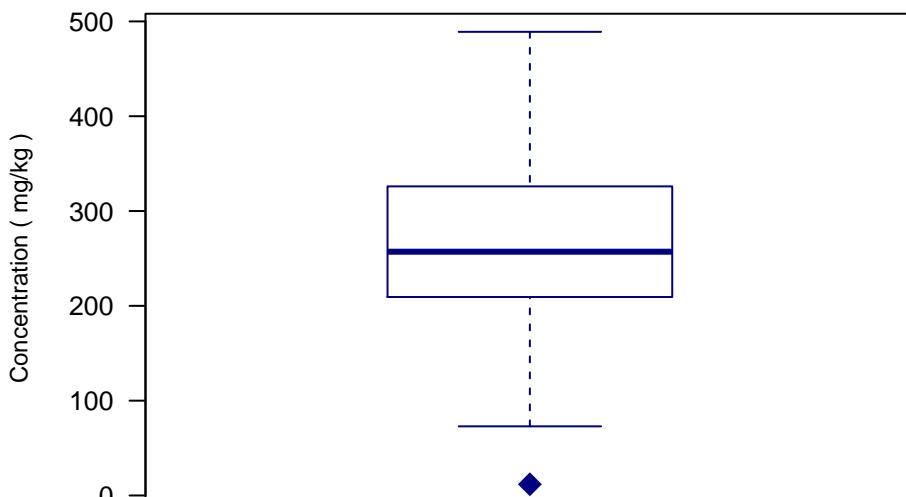


Figure H1-16
Portland Harbor RI/FS
Remedial Investigation Report
Background Upriver Bedded Sediment Outlier Analysis
Phenanthrene (Dry Weight)

Total Petroleum Hydrocarbons (Dry Weight) Concentration versus River Mile



Boxplot



Quantile–Quantile Plot

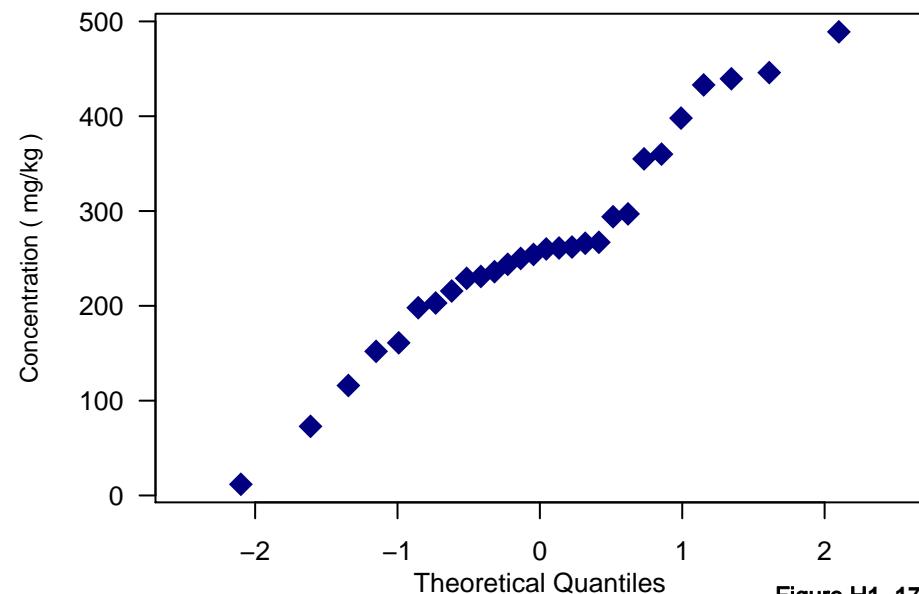


Figure H1-17
Portland Harbor RI/FS
Remedial Investigation Report
Background Upriver Bedded Sediment Outlier Analysis
Total Petroleum Hydrocarbons (Dry Weight)

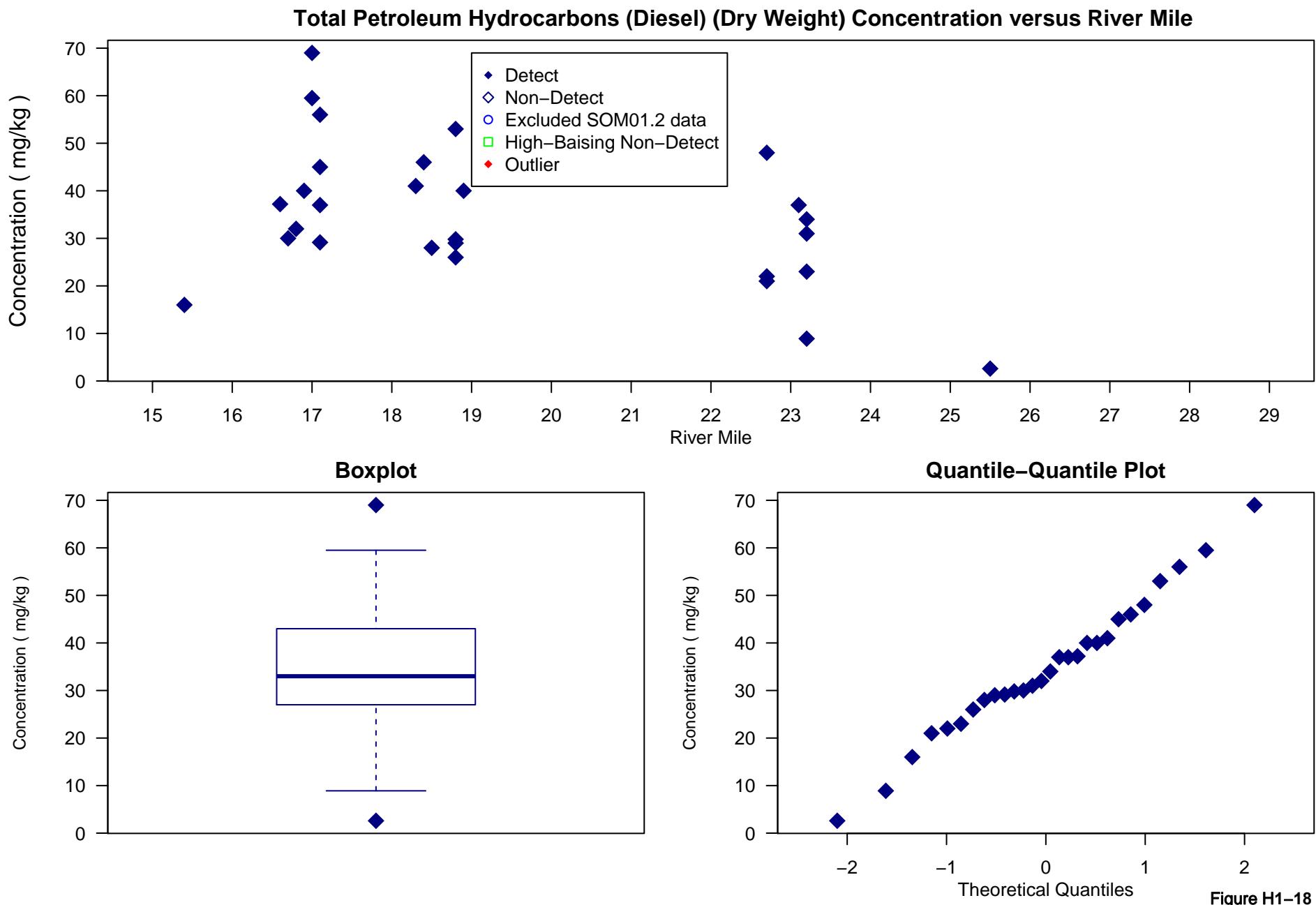
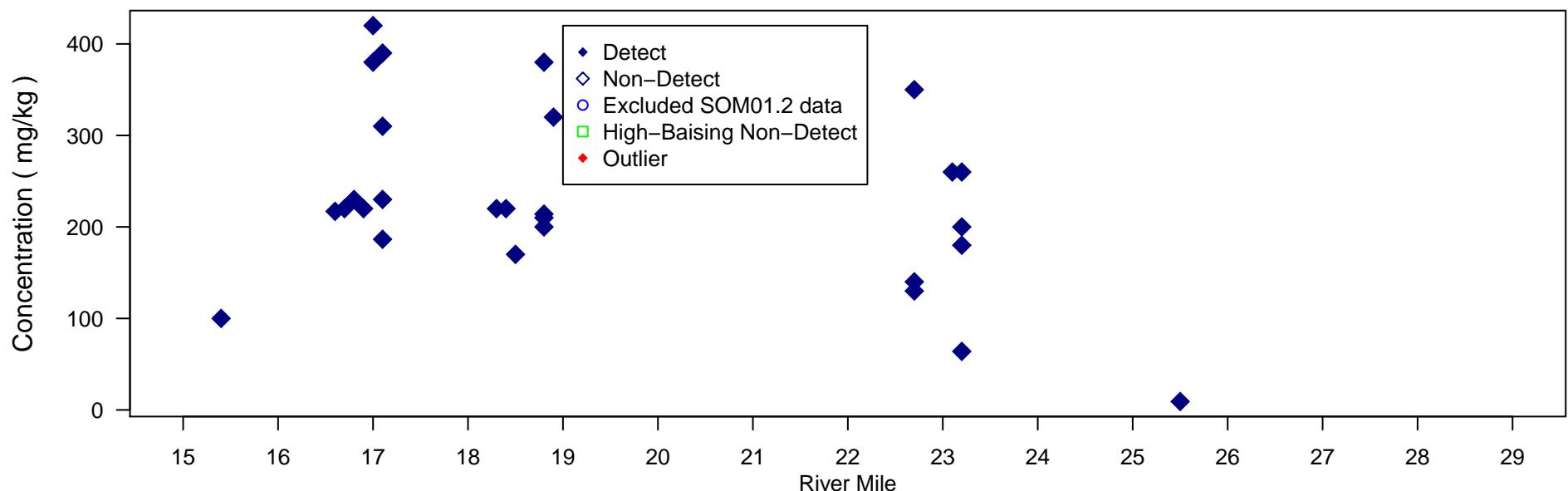
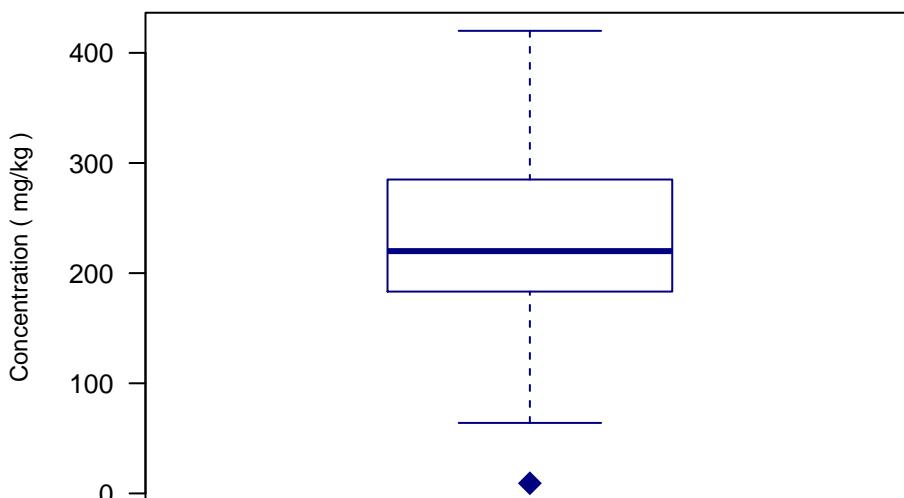


Figure H1-18
 Portland Harbor RI/FS
 Remedial Investigation Report
 Background Upriver Bedded Sediment Outlier Analysis
 Total Petroleum Hydrocarbons (Diesel) (Dry Weight)

Total Petroleum Hydrocarbons (Residual) (Dry Weight) Concentration versus River Mile



Boxplot



Quantile–Quantile Plot

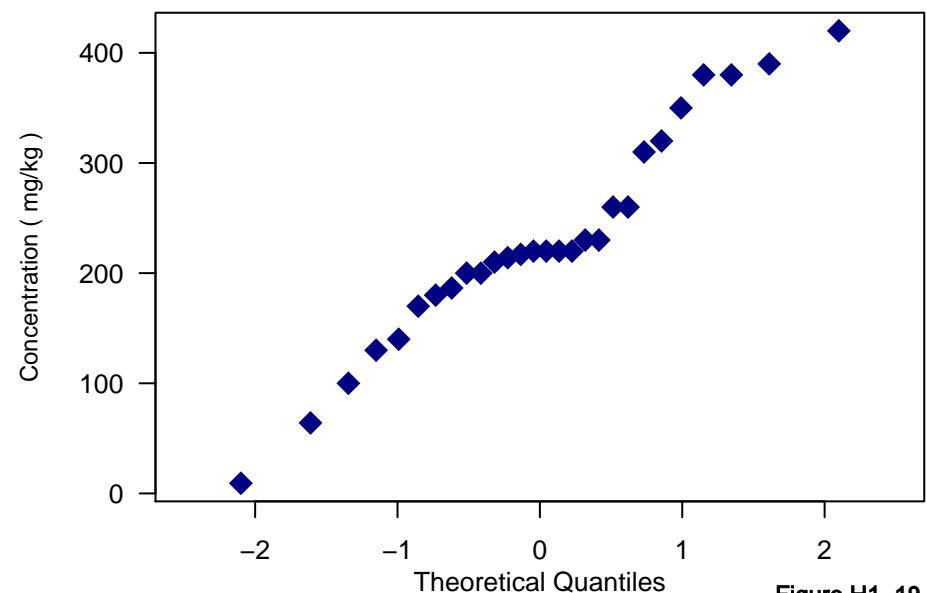


Figure H1-19
Portland Harbor RI/FS
Remedial Investigation Report
Background Upriver Bedded Sediment Outlier Analysis
Total Petroleum Hydrocarbons (Residual) (Dry Weight)

TABLES

Table H1-1. Upriver Surface Sediment Summary Statistics, Dry Weight Concentrations, All Data.

Analyte	Units	Sample Counts				Detection Frequency (%)	Data Summary		Detectors	Detectors
		High Biasing Non-detects	Sample Count	Detects	Non-detects		Non-detects	Minimum	Maximum	
Benzo(a)pyrene	µg/kg	0	71	42	29	59	0.33	21	0.53	53
Butylbenzyl phthalate ^a	µg/kg	1	69	15	51	23	2.2	45	2.7	33
Cadmium	mg/kg	0	67	58	9	87	0.04	0.11	0.04	0.3
cPAHs	µg/kg	0	71	59	12	83	0.39	10	0.66	76.99
Total DDD ^b	µg/kg	0	48	39	9	81	0.051	1.8	0.14	1.62
Total DDE ^b	µg/kg	0	48	47	1	98	0.12	1.8	0.11	2.45
Total DDT ^{a,b}	µg/kg	0	48	18	30	38	0.05	1.8	0.32	2.97
gamma-Hexachlorocyclohexane (Lindane) ^a	µg/kg	3	45	1	44	2	0.06	0.91	0.32	0.32
Hexachlorobenzene ^c	µg/kg	14	34	24	10	71	0.07	45	0.08	1.04
Total HPAHs	µg/kg	0	71	59	12	83	1	10	4.73	450
Lead	mg/kg	0	67	67	0	100	0	0	3.96	31.6
Total LPAHs	µg/kg	0	71	48	23	68	1.5	10	2.34	96
Naphthalene ^a	µg/kg	6	65	20	45	31	0.55	13	1.1	9.9
Nickel	mg/kg	0	67	67	0	100	0	0	12.3	29
Pentachlorophenol ^a	µg/kg	6	65	9	56	14	0.25	60	1.5	12
Phenanthrene	µg/kg	0	69	33	36	48	0.59	13	0.91	71
Total Petroleum Hydrocarbons	mg/kg	0	28	28	0	100	0	0	12	489
Total Petroleum Hydrocarbons (Diesel)	mg/kg	0	28	28	0	100	0	0	2.6	69
Total Petroleum Hydrocarbons (Residual)	mg/kg	0	28	28	0	100	0	0	9.2	420

Notes:

^a Indicates data has a detection frequency of less than ~ 50%

^b Indicates data analyzed by Method SOM01.2 were excluded

^c Indicates only data analyzed by Method SW-8081A were used in calculating background values

cPAH - carcinogenic polycyclic aromatic hydrocarbon

DDD - dichlorodiphenyldichloroethane

DDE - dichlorodiphenyldichloroethylene

DDT - dichlorodiphenyltrichloroethane

HPAH - high-molecular-weight polycyclic aromatic hydrocarbon

LPAH - low-molecular-weight polycyclic aromatic hydrocarbon

Table H1-2. Summary of Background Results, Dry Weight and OC-Equivalent Concentrations.

Analyte	Units	Distribution	All Data						Outliers Removed						Notes:	
			95% UPL			95% UCL			No. Outliers Removed	95% UPL			95% UCL			
			Type	UPL	UPL - OC Equivalent	Type	UCL	UCL - OC Equivalent		Type	UPL	UPL - OC Equivalent	Type	UCL	UCL - OC Equivalent	
Benzo(a)pyrene	µg/kg	Approx. Lognormal	Log ROS-t	19.4	29.8	Normal KM-t	7.34	11.3	5	Normal KM-t	9.97	15.4	Normal KM (% bootstrap)	4.73	7.3	Data are normal with outliers removed
Butylbenzyl phthalate	µg/kg	No background calculated, insufficient detections														
Cadmium	mg/kg	Gamma, Approx. Lognormal	Log KM-t	0.24	0.36	Gamma ROS	0.128	0.20	1	Normal KM-t	0.191	0.29	Normal KM-t	0.123	0.19	Data are normal with outlier removed
cPAHs	µg/kg	Lognormal	Log KM-t	38.5	59.3	Normal KM (BCA)	11.7	18.0	5	Normal KM-t	14.81	22.8	Normal KM-t	7.63	11.8	Data are normal with outliers removed
Total DDD ^a	µg/kg	Gamma, Lognormal	Hawkins-Wixley	1.8	2.8	Gamma ROS	0.8	1.2	0	Hawkins-Wixley	1.82	2.8	GROS Adjusted Gamma UCL	0.8	1.2	No outliers
Total DDE ^a	µg/kg	Approx. Normal, Gamma, Approx. Lognormal	Normal KM-t	1.9	2.9	Normal KM-t	1.1	1.7	0	Normal KM-t	1.89	2.9	Normal KM % bootstrap)	1.1	1.7	No outliers
Total DDT ^a	µg/kg	No background calculated, insufficient detections														
gamma-Hexachlorocyclohexane (Lindane)	µg/kg	No background calculated, insufficient detections														
Hexachlorobenzene ^b	µg/kg	Lognormal	Log KM-t	0.79	1.22	Normal KM (BCA)	0.37	0.57	7	Normal KM-t	0.294	0.45	Normal KM-t	0.188	0.29	Data are normal with outliers removed
Total HPAHs	µg/kg	Gamma, Lognormal	Hawkins-Wixley	235.3	362.4	Gamma ROS	90.7	139.7	3	Normal KM-t	127.3	196.0	Normal KM (% bootstrap)	61.7	95.0	Data are normal with outliers removed
Lead	mg/kg	Nonparametric	None	15.7	24.2	Normal Modified-t	9.29	14.3	6	Normal-t	10.0	15.4	Normal Student's-t	7.69	11.8	Data are normal with outliers removed
Total LPAHs	µg/kg	Approx. Gamma, Approx. Lognormal	Hawkins-Wixley	33.7	52.0	Gamma ROS	15.5	23.8	1	Normal KM-t	23.8	36.6	Normal KM-t	11.6	17.8	Data are normal with outlier removed
Naphthalene	µg/kg	No background calculated, insufficient detections														
Nickel	mg/kg	Normal, Gamma, Approx. Lognormal	Normal-t	26.2	40.3	Normal Student's-t	21.4	32.9	0	Normal-t	26.2	40.3	Normal Student's-t	21.4	32.9	No outliers
Pentachlorophenol	µg/kg	No background calculated, insufficient detections														
Phenanthrene	µg/kg	Lognormal	Log KM-t	15.27	23.5158	Normal KM-t	6.417	9.882	2	Normal KM-t	8.808	13.564	Normal KM-t	4.093	6.30322	Data are normal with outliers removed
Total Petroleum Hydrocarbons	mg/kg	Approx. Normal	Normal-t	458.9	706.7	Normal Student's-t	300.5	462.8	0	Normal-t	458.9	706.7	Normal Student's-t	300.5	462.8	No outliers
Total Petroleum Hydrocarbons (Diesel)	mg/kg	Normal, Approx. Gamma	Normal-t	60.3	92.8	Normal Student's-t	39.4	60.7	0	Normal-t	60.3	92.8	Normal Student's-t	39.4	60.7	No outliers
Total Petroleum Hydrocarbons (Residual)	mg/kg	Approx. Normal	Normal-t	399.7	615.5	Normal Student's-t	261.2	402.2	0	Normal-t	399.7	615.5	Normal Student's-t	261.2	402.2	No outliers

Notes:

^a Indicates data analyzed by Method SOM01.2 were excluded

^b Indicates only data analyzed by Method SW-8081A were used in calculating background values

The OC-equivalent values were calculated by multiplying the dry weight values by the ratio of the Study Area average total organic carbon content (1.71%)* and the average total organic carbon content of the background data set (1.11%), i.e., 1.71/1.11 or 1.54.

* This Study Area average surface sediment TOC is based on the RI data set compiled through June 2008 for the 2009 Draft RI report. The Study Area average TOC surface sediment for all data compiled through July 2010 for this Final RI report is 1.79%.

cPAH - carcinogenic polycyclic aromatic hydrocarbon

HPAH - high-molecular-weight polycyclic aromatic hydrocarbon

HW - Hawkins Wixley

KM - Kaplan-Meier

LPAH - low-molecular-weight polycyclic aromatic hydrocarbon

OC - organic carbon

PAH - polycyclic aromatic hydrocarbon

ROS - regression on order statistics

UCL - upper confidence limit

UPL - upper prediction limit